



The Blast Furnace and Steel Plant

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The Blast Furnace *and* Steel Plant

Blooming Mill Connecting Rod Repair

Rapid Thermit Repair Made on Connecting Rods of Reversing Blooming Mill Engine—Vibration Shakes Controlling Lever Out of Place; Connecting Rods and Cylinder Heads Break as Result.

An interesting repair on a blooming engine connecting rod was recently made by the Pittsburgh Reinforced Brazing & Machine Co. at the Aliquippa works of Jones & Laughlin, at Woodlawn, Pa. Due to the fact that this mill was working on government orders, and inasmuch as no finished connecting rods of this size were obtainable, quick action was required. Within five days after the accident, which broke two connecting rods and smashed several cylinder heads, the engine was again in operation.

The accident occurred when the attendant left the controlling lever without putting the locking pin in place. Vibration shook the lever loose and the engine

pletely broken off, while another was cracked. The thermit repair was made in a remarkably short time.

The blooming mill engine is twin-tandem-compound, condensing, direct-connected reversing. The engine, which was designed to operate under a steam pressure of 150 pounds per square inch and to develop efficiently, at 100 revolutions per minute, 20,000 hp, has high-pressure cylinders 44 inches in diameter, and low-pressure cylinders 70 inches in diameter. The connecting rods are steel forged and are 13 feet 9 inches, center to center, of wrists. The rods are of different sizes, the one on the mill side of the engine being the larger. The smaller rod has a solid crank end fitted



Fig. 1—Connecting rod in position to be welded prior to pouring of thermit.

ran away. The inertia stresses, which are, of course, exceptionally high in an engine running above normal speed, were probably the cause of the break. It will, however, also be noted that the design of the connecting rod was such as to render it liable to accident. Sharp corners cause great stresses and it will be noted from the illustration that the corners where the breaks occurred are absolutely sharp. The corners were designed in this manner, due to a claim from the workmen at the time the engine was built, that the keys could be better fitted. One connecting rod was com-

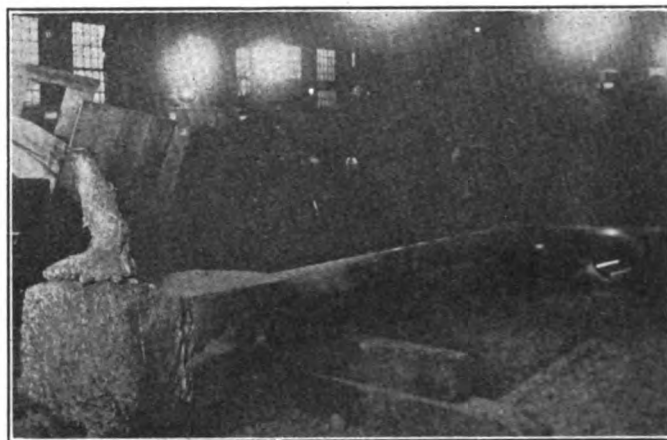


Fig. 2—New end welded on connecting rod—Note sharp corners where break occurred.

with brasses, lined with babbitt metal and adjusted with steel wedges and bolts. The larger rod has a marine type crank end of forged steel, the cap being held to the connecting rod by two nickel steel bolts of $7\frac{3}{4}$ inches diameter. The diameter of the wrist of the smaller rod is 19 inches and its length is 14 inches. The cross-head end of this rod is fitted with a strap, gib and key, with brass bearings for the journal, which are 14 inches diameter and 15 inches long. The wrist of the larger rod is 27 inches diameter by 17 inches long.

Elements of Roll Pass Design

Continuation of Series — Theoretical Explanation of the Often Rather Unexpected Behavior of Metal in the Rolls — Analysis of Deformation of Sheet Bar.

By W. TRINKS.

Sheet and tin plate bars are long bars of flat rectangular section. They are usually 8 inches wide, and vary in thickness from $\frac{1}{4}$ to $\frac{3}{4}$ inch, depending upon the gage of sheet which is to be made from them. Fig. 1 shows the direction of rolling for the bar; it also shows how the sheet is rolled from the sheared bar at right angles to the original direction of rolling.

To the uninitiated the rolling of sheet bar will probably appear to be a very simple matter, such as just starting with a slab of the proper width and keeping on rolling down, until the desired thickness has been reached.

Any such method overlooks the difficulties (mentioned in previous issues) which arise if material is continually compressed in the same direction without edging or turning. On account of lateral spreading, the outer fibers of the bar are not elongated by direct compression, but by tension, being pulled along by the inner fibers. Fine hair cracks appear at the edges, as indicated in Fig. 1. In the finished sheet or tinplate they become quite deep and produce much waste material. The cracks are avoided, if the lateral spreading is limited to a value considerably smaller than that which corresponds to the natural spreading in an open pass. Carrying this reasoning into practice requires rolling in closed passes, such as are diagrammatically shown in Fig. 2. For the purpose of avoiding fins, the corners of the passes are usually broken (chamfered) or rounded (filleted). The problems, how much lateral spreading to allow, and how much chamfer to provide have, of course, been solved experimentally in practice. The cost of cut-and-try methods on rolling sheet bars has run into hundreds of thousands, so that a theoretical investigation of the underlying principles will not be amiss.

The method used in the present essay is identical in principle with that used in the December, 1917, issue of this paper, when a series of rolling squares and ovals was discussed. It consists in analyzing the deformation of the steel step by step, as it travels through a given pass. In the present article, passes of three different mills are investigated. The method

in question is slow and tedious. It requires two hours' work over the drawing board to find out that which the experienced roll designer considers as something that is well understood. Yet, the time required for the analysis is well spent, because the information gained thereby will prove to be of value in the design of passes for more complex sections.

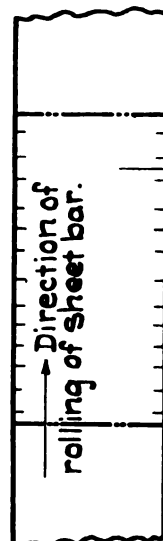


Fig. 1—Directions of rolling for sheet bar and for sheets.

Fig. 3 is a graphical analysis of a pass in a sheet bar mill of one of the largest producers of such bars in the United States. Vertical sections through rolls and bar were taken, from the plane where the bar first touches the rolls up to the plane where contact ceases. The numbers of the sections correspond with those marked on the periphery of the rolls. Turning to the entering section on the extreme right, we notice that the bar touches the top roll with its whole straight part,[†] while it touches the bottom roll in the corners. Bearing in mind that plastic material flows or escapes in the direction of least resistance, we recognize that the whole section may bend, as indicated in Fig. 4, or else, that there may be local deformation as indicated in Fig. 5, each horizontal line HH changing to a curved line CH. Deformation of the character shown in Fig. 4 would occur, if the bar were subjected to this bending action over its whole length. But the bar is straight before entering, and is undoubtedly straight from section 4 on. The bending moment exerted over the short section from plane 2 to plane 4 cannot bend the bar, which is straight on both sides of that short section. Consequently, local deformation of the character indicated in Fig. 5 must occur. On account of the bottom roll being forced into the bar in the direction of the arrow A, the local flow is mainly upward. However not all of it is up-

[†] Strictly speaking, this is true only when the bar first enters the rolls. When the entering section of the bar has passed the center line of the rolls, it touches in the bottom corners without at the same time touching the top. The stiffness of the bar (in addition to the reaction from a guide box, if such is used) then takes up the upward thrust. This shifts the centerline between the rolls to A-A in sections 1 and 2, Fig. 3, and shifts the roll outline to B-B for section 1 and to C-C for section 2. The general principle of the present analysis is not materially affected thereby.

* This article is a continuation of the series which began in THE BLAST FURNACE AND STEEL PLANT in 1917. For the information of new readers the statement is now repeated that this series is not intended for the experienced roll-pass designer, but for those who are less advanced and who wish to have a theoretical explanation for the often rather unexpected behavior of metal in the rolls.

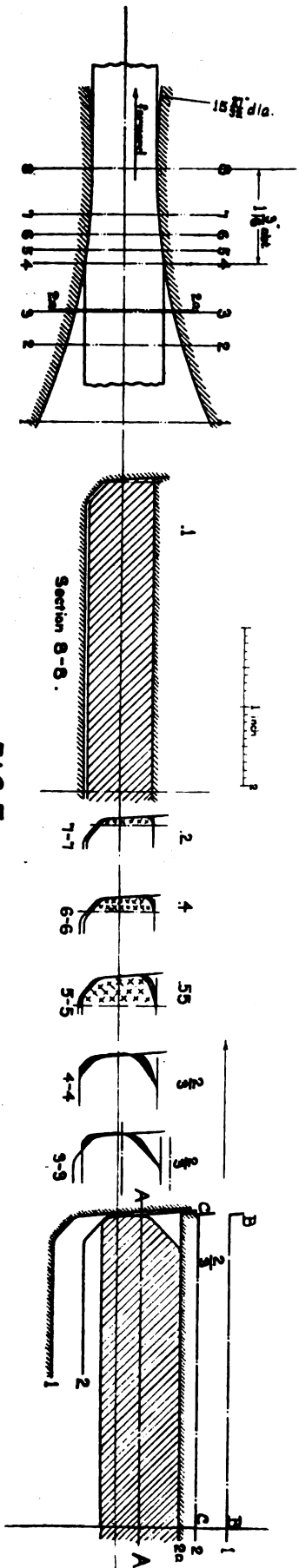


FIG. 3.

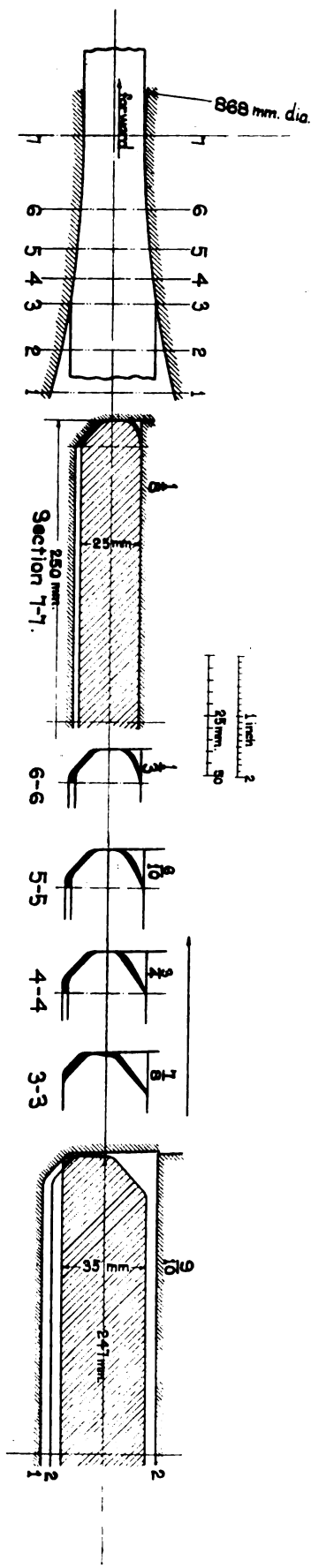
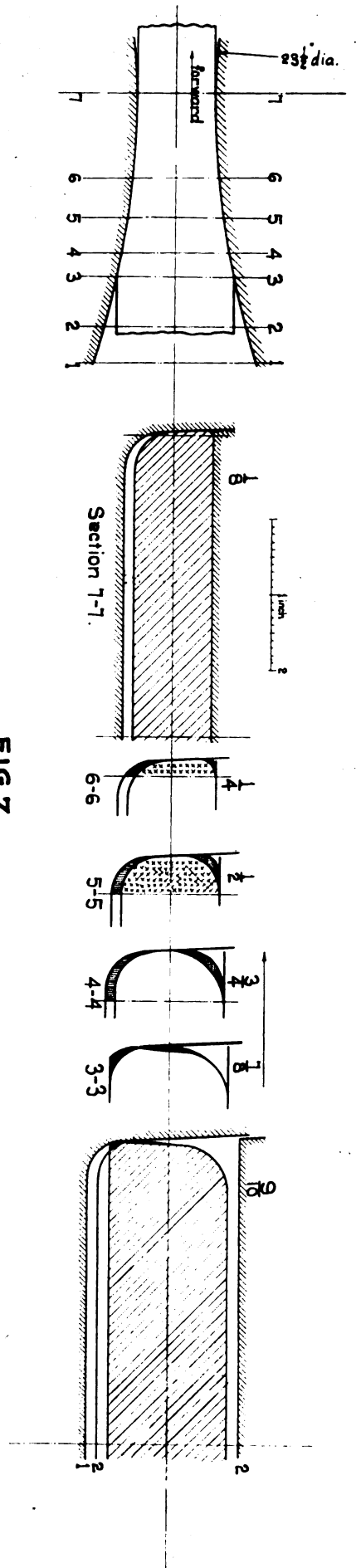


FIG. 6.



ward, because there is a component in the direction of the arrow B (Fig. 5) which causes a slight lateral compression. For that reason only two-thirds of the area displaced by the bottom roll (section lined vertically, section 3, Fig. 3) has been added at the top. One might think that the local compression would

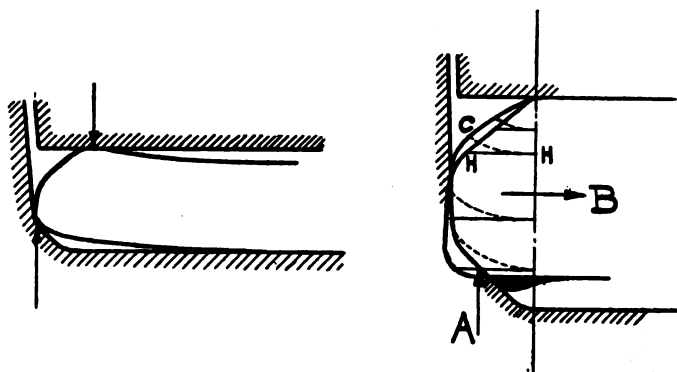


Fig. 2—General diagram of closed passes.

cause the material to squeeze out in a wad as indicated in black at the bottom of the bar, Fig. 5. But such is not the case. Tension at that plane, due to upward bending, prevents the formation of a wad. The same reasoning which was applied to section 3 holds without change for section 4. We note that there is some lateral compression, known as side work, which is beneficial in avoiding cracks.

From section 4 on to the left, the whole bottom of the bar is in contact with the roll. For a determination of the factor of upward displacement in the corners, we must take account of the shape of the projected contact area. In this case, its length in the direction of rolling is roughly $1\frac{3}{16}$ inches, whereas its width is roughly 8 inches. It is, therefore, evident that the lateral spreading of the bar in an open pass would not exceed one-quarter of the draft (see issue of July, 1917), which means that the elongation factor is more than five times the lateral spreading factor. But since lateral spreading is prevented in this case, almost all of the compression goes into elongation. Hence, the areas not under direct compression (marked by crosses in sections 5 and 6) are pulled along by the elongation of the center part of the bar. As we approach the final section 8, frictional resistance to forward motion becomes less and less.

Both the just mentioned actions combine to move a smaller fraction of the area displaced in the bottom



Figs. 4 and 5—A possible deformation of sheet bar, which however does not occur—Flow of material at edge of bar.

corner to the top. By careful weighing of the various influences against one another, the displacement factors written at each of the sections were arrived at.

It will be noted that the pass is filled nicely. The design of the rolls was either worked out very carefully, or else is the product of long experience.

In Fig. 6 the same process has been carried out for a pass of a German sheet-bar mill. After the detailed explanation of Fig. 3, very little comment is needed for Fig. 6, with the exception of those features which are different. It will be noted that the pass allows 3 mm (about $\frac{1}{8}$ inch) spreading. The immediate result is that in the entering sections, planes 2 and 3, the displaced material from the corners escapes laterally and causes the bar to touch the sides even before the compression over the whole length has begun. The final result is that the pass does not fill as well as that shown in Fig. 3; but no great harm is done, because the succeeding passes are so designed as to fill completely in the last pass. There is some side work in Fig. 6, although not as much as in Fig. 3. It probably produces a good enough sheet-bar, and causes the rolls to last somewhat longer.

In Fig. 7 the reasoning of Figs. 3 and 6 has been repeated for a sheet-bar pass of a mill in the Central West of the United States. Although the pass allows $\frac{1}{8}$ inch lateral spreading, which corresponds to the amount allowed in Fig. 6, the pass fills completely. This is due not only to the greater thickness of the bar, but much more to the circumstance that the corners of the pass are rounded, and not chamfered

like those of Figs. 3 and 6. If the corners had been broken by a straight line between the points of tangency of the fillet, as indicated in Fig. 8, the pass would not have been filled. With regard to side work and lasting qualities of rolls, the pass is similar to that of Fig. 6, except that the side work is more evenly distributed over the whole thickness of the bar.

Fig. 7 is a well designed pass. After this mass of theory, a few practical remarks will be welcome.

Careful roll-pass design, taking care of all of the various features explained in the present essay, is sometimes considered burdensome. It can indeed be obviated in continuous mills by allowing free lateral spreading and by using rolls with vertical axes to put work on the edges. The vertical rolls, which are usually drag rolls, crack the scale so that it can easily be blown off by air or steam.

In non-continuous mills the use of vertical drag rolls is not possible. The rolls would have to be driven like the vertical rolls in a universal mill. This complication is seldom used in practice. It is, however, possible to get rid of most of the scale by an edging pass. Such a pass can easily be arranged while the bar is more than 2 inches thick. Below that thickness, handling and holding the bar in the pass is difficult. The greatest advantage of the vertical pass is the cracking and dropping off of the scale. If the bar is too thin in the vertical pass, it must be guided or held so closely that there is not enough freedom for the scale to drop away.

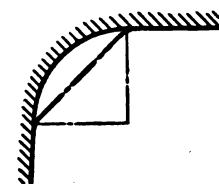


Fig. 8—Influence of corner design and sheet bar.



Recent Advances in Steel Mill Lighting

Particular Attention Called to Interior Lighting — Cost of Effective Illumination Compared to Time-Saving Value. Artificial Light Sources Classified and Discussed.

By **WARD HARRISON.**

PART II.

The unprecedented stimulation of industrial activity arising out of the war may be said to have put artificial lighting on trial as an effective tool of the manufacturer, and there are cases, not a few, where it has been found wanting. Heretofore, artificial light has been required in most instances merely to supplement daylight; night operation has, as a rule, been avoided in factories except where from their very nature processes must be continuous. Fortunately the illumination required for most of these, as for example, the operation of furnaces in the manufacture of steel, was not of a very high order. Today, on the other hand, many industries involving close detail work are called upon to double or triple their production and that without the lapse of sufficient time to increase the size of their plants. This, of course, means night operation, and whereas in the past the effectiveness of one system of artificial lighting has been compared simply with that of another, the value of all is now being judged in direct comparison with daylight as the standard.

The second part of abstract of paper, read before A. I. S. E., Pittsburgh section meeting.

Obvious deficiencies of the old illuminants were low efficiency and high cost of operation, and consequently a lack of adequate intensity when compared with daylight. At the present time, however, light costs only one-seventh of what it did 10 years ago, and artificial illumination of daylight intensity may be produced at a moderate expense; in fact, such intensities are now being supplied in more instances than most people realize. Nevertheless, judged from the standpoint of satisfactory and comfortable vision, there are few, even among these installations, which can bear comparison with daylight.

Good lighting involves something more than mere intensity and as experience with daylight lamps has shown something even more than simply proper intensity and color, the truth of the matter is that, disregarding cost, the same intensities produced with the illuminants available 50 years ago, would have more nearly fulfilled the requirements of good lighting than do many present-day installations. The light sources of that time were for the most part of such moderate intensity and brilliancy as to render unnecessary any special precautions in their use. When railway trains

ran 15 miles an hour, block signals were unknown and there was little need for a rock-balanced roadbed. Unfortunately, in this era of high speed trains, high-powered automobiles and high-intensity lamps, too many of us are prone to believe that precaution is necessary with the first named only.

It is true that as the intensity and intrinsic brilliancy of our light sources have increased, reflectors of better design have also become available. These have shielded the eye to some extent, but applied to the general illumination of factory areas, the fundamental purpose of such reflectors have been merely that of increasing the percentage of useful light; adding to the comfort of the user has been a secondary consideration. It is only with the latest improvements in incandescent lamps that there has come the realization that if we are to attain a daylight standard in the artificial illumination of factories, we must approach daylight diffusion or "softness" of light. Glare, specular reflection and quality of shadow, are receiving increasing attention. All are dependent, primarily, upon the area of the apparent source of light.

Glare, as applied to light sources, is a term which has not as yet been defined with entire satisfaction. In common usage any light source which is uncomfortably bright is termed glaring, but whether or not a source does produce discomfort is dependent in large measure upon two factors. First, upon the brightness of the surroundings; and, second, upon the length of time during which the eye is exposed to its rays. To illustrate the first; consider for example, that out-of-doors in daylight, one will scarcely notice whether or not a bare Mazda C lamp is lighted, even

though close at hand, whereas at night in dark surroundings the same lighted filament would in most cases be decidedly uncomfortable. As regards the effect of length of exposure to a light source, one will recall that to sit all day at a desk facing a window will cause most pronounced fatigue; although, on the other hand, one may casually look out of the window from another location many times during the day without experiencing any sensation of discomfort.

From the standpoint of glare, artificial light sources may be divided into three classes:

(1) Those such as the arc or bare lamp filament which amid given surroundings cause discomfort at once. It is the growing conviction that under no circumstances should sources of this class be tolerated within the field of vision.

(2) Light sources which are not recognized immediately as uncomfortable, but which after a time give rise to fatigue. Examples of locations in which such sources may properly be used include all passageways, storerooms, and other places where workmen are not employed continuously; also a great many factory warehouses where close vision is not required and the operators move about, so that the light sources are not always in the same part of the field of vision. Unfortunately, limits of

brightnesses for this class of sources, have not as yet been definitely established, but such tests as are available and practical experience alike indicate that where light sources are viewed directly, even for brief intervals, the brightness should not exceed 2 to 3 candle power per square inch, if the sensation of glare is to be entirely avoided. Where lamps are so placed as to be always considerably above the line of vision, higher

TABLE I.

COEFFICIENTS OF UTILIZATION									
This table applies to installations in square rooms having sufficient lighting units symmetrically arranged to produce reasonably uniform illumination. To obtain the coefficient for any rectangular room, find the value for a square room of the narrow dimension and add one-third of the difference between this value and the coefficient for a square room of the long dimension.									
Reflection Factor		Ceiling		Light 70%			Medium 50%		Dark 30%
		Walls		Light 50%	Medium 35%	Dark 20%	Medium 35%	Dark 20%	Dark 20%
Reflector Type	Light Output	Ratio = Room Width Ceiling Height							
Prismatic Glass	90° to 180°—22%	1		.42	.38	.35	.36	.34	.33
		1 1/2		.50	.46	.43	.44	.42	.41
		2		.56	.52	.49	.50	.47	.45
		3		.63	.59	.55	.56	.53	.51
		5		.70	.66	.63	.63	.60	.57
Bowl-Frosted Lamp	0° to 90°—65%								
		1		.31	.27	.24	.24	.21	.18
		1 1/2		.37	.33	.30	.30	.27	.24
		2		.43	.39	.35	.34	.31	.27
		3		.49	.45	.41	.39	.36	.31
		5		.56	.52	.48	.45	.42	.36
Light Opal	90° to 180°—35%								
		1		.41	.37	.34	.35	.33	.32
		1 1/2		.49	.45	.42	.43	.41	.39
		2		.54	.50	.47	.48	.46	.44
		3		.60	.56	.53	.53	.51	.49
		5		.67	.63	.59	.59	.57	.54
Bowl-Frosted Lamp	0° to 90°—50%								
		1		.38	.36	.34	.35	.33	.33
		1 1/2		.45	.43	.41	.42	.40	.40
		2		.49	.47	.45	.46	.44	.44
		3		.54	.52	.50	.51	.49	.49
		5		.59	.57	.55	.56	.54	.54
Steel Bowl	90° to 180°—0%								
		1		.43	.40	.38	.39	.37	.37
		1 1/2		.52	.49	.47	.48	.46	.46
		2		.57	.54	.52	.53	.51	.51
		3		.63	.60	.58	.59	.57	.57
		5		.69	.66	.64	.65	.63	.63
Porcelain Enameled	0° to 90°—65%								
		1		.22	.19	.17	.14	.12	.07
		1 1/2		.27	.24	.22	.17	.15	.09
		2		.31	.28	.26	.20	.18	.11
		3		.36	.33	.31	.24	.22	.13
		5		.42	.39	.37	.28	.26	.16
Indirect	90° to 180°—80%								
		1		.27	.24	.21	.20	.17	.14
		1 1/2		.34	.30	.27	.25	.22	.18
		2		.39	.35	.32	.29	.26	.21
		3		.45	.41	.38	.34	.31	.25
		5		.51	.47	.44	.40	.37	.29
Mirrored Glass	0° to 90°—0%								
		1		.24	.21	.19	.16	.14	.10
		1 1/2		.30	.27	.24	.20	.18	.13
		2		.34	.31	.28	.23	.21	.15
		3		.39	.36	.33	.27	.25	.18
		5		.45	.42	.39	.32	.30	.21
Semi-Indirect	90° to 180°—60%								
		1		.23	.20	.17	.18	.16	.14
		1 1/2		.30	.26	.23	.24	.21	.19
		2		.35	.31	.28	.28	.25	.22
		3		.41	.37	.34	.33	.30	.26
		5		.48	.44	.41	.39	.36	.31
Light Opal	0° to 90°—25%								
		1		.32	.28	.26	.27	.25	.23
		1 1/2		.40	.36	.33	.34	.32	.30
		2		.45	.41	.38	.39	.37	.35
		3		.52	.47	.44	.45	.42	.40
		5		.59	.54	.51	.51	.48	.46
Semi-Enclosing	90° to 180°—20%								
		1		.32	.28	.26	.27	.25	.23
		1 1/2		.40	.36	.33	.34	.32	.30
		2		.45	.41	.38	.39	.37	.35
		3		.52	.47	.44	.45	.42	.40
		5		.59	.54	.51	.51	.48	.46
Opal Bowl	0° to 90°—60%								

values will be found permissible; in fact, for many classes of shops, the use of frosted lamps in dome reflectors hung 10 to 15 feet above the floor is today considered good practice, although the maximum brilliancy may run as high as 75 or 100 candle power per square inch.

(3) Light sources which may remain within the field of view indefinitely without causing any sensation of glare. For the best diffused lighting required for offices and the like, it has been stated that the ratio of contrast between the brightest and darkest objects within the field of view should preferably not exceed 100 to 1, which would mean that under ordinary conditions, the maximum brightnesses of the sources

that the permissible limit of contrast decreases as the general brightness level is raised; so as a matter of fact, it would not be permissible to double the brightness of light sources in a room until the general illumination had been increased to 10 times the former value.

In addition to direct glare from light sources, the element of reflected glare or specular reflection, is, in some locations, of equal or even greater consequence. The eye may be shielded from the direct rays of a lamp, yet the image of this light source, reflected from the polished metal parts of a machine on which one is working, may be the source of most serious discomfort. It is obvious that the lower the brightness of the source the lower the brilliancy, and the less dis-



Fig. 1—Showing arrangement of rows of lights well above cranes, giving even distribution.

should not be greater than one-half candle power per square inch of apparent area. It is found in practice that totally indirect or semi-indirect units of dense glass are required to fulfill the rigorous requirements of this class.

It is interesting to note from Table I, which gives the brightness of various light sources, that the candle flame is the only unmodified source shown which would not be classed as immediately glaring when measured by these criteria. The brightness of the candle flame is not far different from that of the sky, to which, of course, the eye has long been adapted. Formerly it was often assumed that doubling the standard of illumination would permit also of doubling the brightness of the light sources without any tendency to cause glare. Of late, however, it has been shown

comfort from the reflected image. If a light source is satisfactory as to glare when one looks directly into it, in most cases it can be safely assumed that its image will not be disturbing.

A third quality factor which must be considered in industrial illumination is that of vertical illumination, or, rather, illumination of vertical surfaces. In an office one is concerned principally with books, papers and photographs disposed in a horizontal or slightly oblique plane, and it is the lighting of this plane which is of importance. In the factory, on the other hand, objects of three dimensions are the rule, and illumination of their vertical surfaces is of nearly as much concern as that of the horizontal. A good intensity of light on the vertical wall surfaces is also conducive of an impression of brightness and cheer

throughout a room. To provide good vertical illumination, a light source must have a fairly wide distribution of lights; that is, give satisfactory intensity at angles as high as from 65 to 75 deg. from the nadir.

Finally, the question of shadows must be considered. For satisfactory general lighting there must be no shadows so dense as to make vision difficult where the direct light from one or two sources is cut off, nor so sharply defined as to confuse the worker; in other words, shadows should be soft and luminous. In this connection, it must be remembered that the entire elimination of shadows is not an end to be desired in industrial illumination. From successful trials of indirect lighting in offices, some factory managers have drawn the conclusion that the indirect system is ideal for all locations, and that it is simply the question of operating cost and maintenance which has prevented the universal application of this system. However, the distinction must be recognized that in offices close scrutiny is limited to plane surfaces, and that printed words and figures are rendered legible by differences in color and contrasts in brightness with the background. Specular reflection and shadows are of no aid and they usually do harm. On the other hand, it is universally recognized that evenly diffused light makes sculpture appear flat and uninteresting; the eye cannot readily grasp the form of the objects viewed. For the same reason that a directed light is preferred for works of art, it is required for the easy visions of objects of three dimensions in the factory. Here, differences in color and in reflecting power are usually too minute to be depended upon for quick and accurate vision, and a slight specular reflection is often of great assistance, particularly in inspection work.

To sum up, then, the ideal source for factory use must be low in brilliancy to minimize glare and specular reflection, and must show reasonably good candle-power values at angles 65 and 76 per cent to supply satisfactory vertical illumination must be sufficiently large in area to give soft shadows and small enough to insure a directed light.

The foregoing discussion may, perhaps, be made more clear by a comparison of some concrete examples. One of the most popular units developed for general factory lighting was the dome-shaped steel reflector and vacuum incandescent lamp of from 100 to 250 watts. Although the intrinsic brilliancy of the lamp filament was high the reflector shielded the eye to some extent, and hundreds of thousands of such units were used with satisfaction, especially where the mounting height was more than 10 feet above the floor. On the other hand, when a gas filled lamp of corresponding wattage was substituted in the same reflector, the discomfort was greatly due both to the higher intrinsic brilliancy and greater concentration of the filament. The obvious remedy was to use a reflector which protected the eye to a greater degree and consequently

those of the bowl type, were specified in great numbers. This unit shields the eye somewhat from the direct glare, but from the standpoint of specular reflection from working surfaces is, of course, in no way superior to the dome and is markedly inferior to it in efficiency. From the illumination standpoint, the use of a bowl frosted Mazda lamp in a dome reflector is superior to the bowl in almost every respect.

It should be borne in mind that the term dome reflector, as used in this discussion, applies to a rather large reflector having a diameter perhaps five times that of the lamp bulb and so designed that its lower edge comes down appreciably below the center of the lamp filament. The earlier dome types in which the lower edge of the reflector was at the level of, or above the center of filament, are particularly objectionable when used with Mazda lamps (C), either clear bulb or frosted; not only is the brilliant source then visible from almost any position, but in many cases it is seen against the comparatively dark background of a distant wall or window. When using a properly designed dome reflector, the filament can, at worst, be seen only against a white reflecting surface; a factor which considerably reduces contrast and glare.

An entirely different aspect of factory lighting which is worthy of serious attention is one of economics. Many engineers are already familiar with data which show how insignificant the cost of good illumination is in comparison with the value of a workman's time. In fact, one need frequently save only 30 or 40 seconds in an hour to entirely offset the cost of lighting. There is also another consideration, namely, the saving in overhead expense which may be effected by using a factory building and its equipment for a greater number of hours per day, made possible by adequate provision for the artificial lighting.

As an illustration, let us take the case of a manufacturing concern operating to full capacity on a day-shift only. To increase the output of the plant to meet any further demand it becomes necessary either to provide additional machinery and working space, or to operate the plant at night. Except for these industries which by nature require continuous operation, night work in the past has always been looked upon with disfavor; simply dismissed from consideration with the statement that men cannot work efficiently under artificial light. In general this has been true, but would it not be worth while to determine how much the cost would be to illuminate a plant at night in a manner to compare favorable with daylight in every respect, in intensity, softness, diffusion, and, if necessary, even in color? To do this it is first necessary to know how much light is obtained during the day. Such data has been accumulated. An illuminometer of new design, which is direct reading and portable, has made it possible to obtain illumination values very rapidly.

New Booth-Hall Electric Steel Furnace

Furnace for Use on Either Single, Two- or Three-Phase Power Lines for Melting Scrap Steel, Ranging from Machine Shop Turnings to Heavy Melting Steel.

The creation of a new type of electric steel furnace by American engineers has been one of the important developments in this industry during the past year. The Booth-Hall electric steel furnace was originated by William K. Booth, and its mechanical design carried out by Julius R. Hall, both of Chicago.

This furnace is built for use on either single, two or three-phase power lines and the furnace itself is built to operate either single, two or three-phase. The single-phase furnace employs an auxiliary electrode, a main electrode, a conducting hearth and a cast steel grid buried under the hearth. The two-phase furnace employs two main electrodes and two grids, whereas the three-phase furnace employs three main electrodes but only one grid. It is anticipated that the furnace for single-phase operation will be built only in the smaller sizes, as a single-phase load of any considerable size is not acceptable to power companies. Three-phase operation will be employed only in the largest capacities where the increased number of electrodes will tend to facilitate melting down and refining. The two-phase furnace will be suitable under most conditions, and it is with such a furnace that this article deals.

The Booth-Hall electric steel furnace, shown in the accompanying illustrations, was recently placed in operation in the plant of the Midland Electric Steel Company, Terre Haute, Ind. The furnace has a holding capacity of three to five net tons and is supplied by two single-phase transformers of 600 kva capacity each. The transformers are Scott connected to the 13,200 volt, 60-cycle, three-phase power line, and deliver current to the furnace at 125 volts secondary. The Scott connection gives a load well balanced over the three-phase primary circuit, as is evidenced by the meter readings. A special switch is provided for cutting the voltage in half when refining or holding heats. The electrodes are automatically regulated and, by

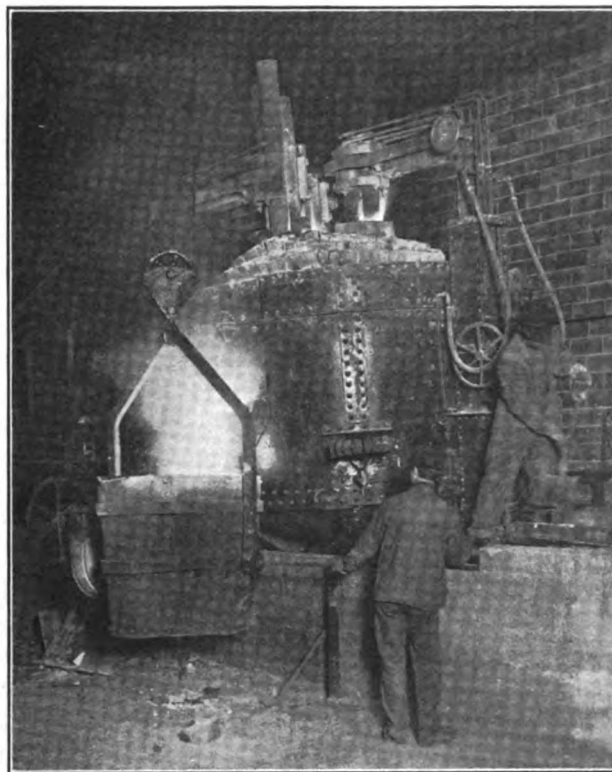
proper manipulation of the electrode regulators and the voltage reduction switch, it is possible to put any fraction of full power into the furnace. The furnace operates at about 90 per cent power factor, giving a power input at full load of from 1,000 to 1,100 kw.

Scrap steel, ranging from machine shop turnings to heavy melting steel, is charged into the furnace. When the furnace is charged, the auxiliary electrode and the two main electrodes are let down until they rest upon the scrap. A pawl upon the auxiliary electrode holder is released, so that the electrode rests of its own weight upon the scrap, and the main electrodes are drawn up, creating an arc under each electrode, the arc being governed by the automatic electrode regulators, assuring a uniform power input into the furnace and a nicely balanced load in the power lines. This results in heat being generated by the two arcs from the main electrodes to the scrap, while the auxiliary electrode, under which no arc is formed, acts as the common return. By reason of the electrode resting of its own weight upon the scrap, no arc can form under the auxiliary.

When a pool has been formed on the hearth suffi-

cient to make it conducive of electricity, the current begins to flow through the hearth and out through two sets of steel grids imbedded beneath the hearth. The fact that this is taking place is immediately recorded by the ammeters, and the auxiliary electrode is then drawn up sufficiently out of contact with the scrap, and forms its own seal of the electrode opening in the roof. The furnace then continues to operate as a two-phase furnace, with two independent circuits, the current from one side of each transformer making a complete circuit through one electrode, across the arc, through the bath and the hearth to the opposing grid, and so back to the other side of the transformer.

It is to be noted that the auxiliary electrode is withdrawn before the scrap underneath melts, and



Pouring hot metal from Booth-Hall electric furnace.

consequently no carbon is absorbed by the liquid steel from this source.

The advantages claimed for this principle of operation are:

1. The use of the auxiliary electrode renders the starting of every heat positive and does away with trouble in making contact.

2. The use of the conducting hearth gives uniform heating of the entire bath, prevents sculls and makes speedier and more thorough distribution of the heavier alloys, such as chrome, tungsten, vanadium, manganese and nickel, which sink to the bottom of the bath.

3. The use of two independent circuits, criss-crossing in the bath, combined with bottom heating, gives a maximum circulation of the bath.

4. The use of an auxiliary electrode in combination with a conducting hearth enables the use of a minimum number of electrodes for multi-phase service, since the auxiliary electrode is used only at the very beginning of the heat when conditions are least severe. This results in lower electrode consumption and reduction in heat losses.

5. The hearth is solid, similar to the open hearth, with no openings or bottom contact to weaken the lining, and is sintered in place, layer by layer, forming a monolithic mass. There is no water-cooling of hearth or grids, and the operation of the furnace has shown that none is necessary.

On an absolutely cold bottom it is necessary to employ the auxiliary electrode for about 45 minutes before the hearth becomes conductive of electricity. On a furnace that has been shut down over night, it requires from 20 to 30 minutes, and on a hot furnace not more than 10 minutes, and frequently not at all.

As shown in the accompanying illustrations, the Booth-Hall furnace is spherical in shape with a saucer-like bottom and a roof built up of standard silica shapes. The use of standard silica shapes for the roof does not produce either as satisfactory a type or as neat appearing as would be the case with specially designed brick, but has been adopted as a practical measure to save time on the delivery of brick. It is always possible to pick up standard shapes in silica brick, whereas special designs are very hard to get.

The builders of the Booth-Hall furnace have consistently used, throughout its construction, standard material so that replacements can be readily and quickly made at small cost.

The furnace shell is made of $\frac{1}{2}$ inch riveted steel plate. The main electrodes are placed on opposite sides of the furnace, and the auxiliary electrode directly alongside of one of the main electrodes and toward the front of the furnace (see Fig. 1). The door for charging and slagging is placed directly in the rear (see Fig. 2). The copper flexibles and electrode motors are placed in separate pits on either side of the furnace, and the tilting mechanism is placed in the rear of the main furnace pit, so that there is no tilting machinery immediately under the furnace. The substation (see Fig. 3) may be placed either directly back of the furnace or to either side. In this installa-

tion, it is directly back of the furnace. The current is brought from the transformers to the furnace by means of copper bus bars, properly interlaced to cut down the reactance of the circuit. These are installed so that they can be adjusted to vary the reactance to suit the power service conditions.

The furnace may be lined either basic or acid; the unit at Terre Haute being lined basic. The hearth is 24 inches thick and the grids are 18 inches below the top of the hearth. The furnace hearth is composed chiefly of either magnesite or dolomite and is solidly sintered in, layer on layer. From the hearth up, the walls are made of brick, the first three rows which reach above the slag line being made of magnesite brick and the rest of silica brick. Silica brick are employed for the roof.

The furnace door is of improved design (see Fig. 4), consisting of a door with open back to which is attached two yokes, each counterweighted. The yokes extend part way from the door toward the sides of the furnace and, by reason of the counterweights, the door can be raised with one hand by the furnace operator. The door is built in with brick, the open back allowing radiation of the heat and preserving the brick. The door pivots on the yokes as it is raised and lowered, keeping the hot innerside always to the furnace wall. The door is oval in shape, so that there is no tendency to breast up the opening, as is done where round doors are employed and there is, therefore, maximum charging space. It is possible to raise the door as far as required, so that for looking into the furnace for rabbling or for taking out test ladles, the entire opening does not have to be employed. The door comes down flush against the doorframe, preventing heat losses from the furnace and also the seeping of air into the furnace to disturb the furnace conditions. The doorframe is made in two sections, one of which extends across the top, and can be readily replaced when burnt out.

By placing the door in the rear of the furnace, charging and slagging operations are simplified. By tilting the furnace forward, it is possible to charge the furnace quickly by the use of a hopper arrangement similar to that used for charging concrete mixers. By tilting the furnace backward, it is possible to bring the slag flush with the doorsill, either for rabbling or for pouring it off into slag pots. It is also practical to pour fluid slags over the charging spout.

The furnace rocks either forward or backward upon 100-pound steel rails, bolted on to the concrete foundation piers which separate the side pits under the electrode holders from the main furnace pits. This places the bearing at the outer edge of the furnace, giving a wide base, and less opportunity for jerking movements which might snap off the electrodes and injure the refractories. Three lugs, or teeth, are bolted to each rail, extending over the rail and meshing with slots in the tread casting, which is bolted to the side

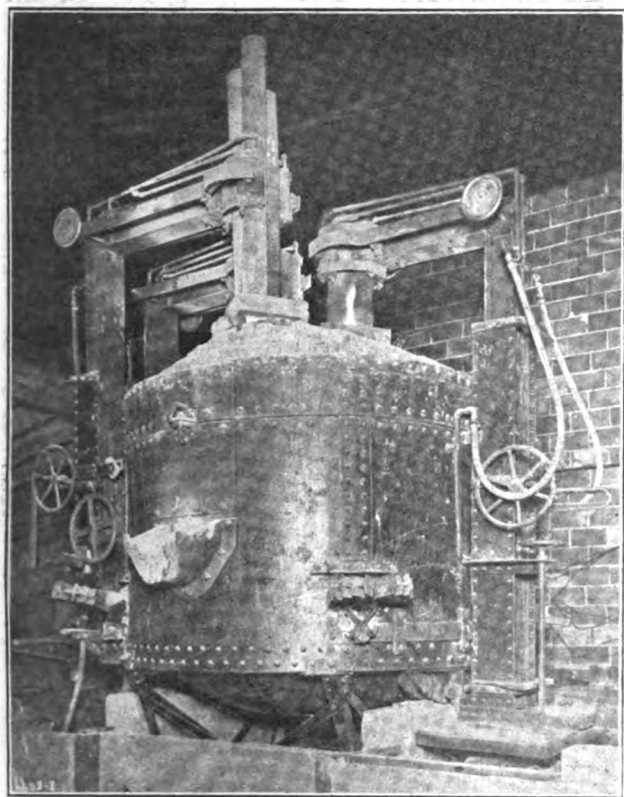


Fig. 1—Showing main and auxiliary electrodes.

of the furnace. The furnace, therefore, rolls back and forth upon the rail and is prevented from slipping by the tooth on the rail. The tilt is controlled by an A frame, cross-braced, which extends down into the main pit on each side of the furnace, connected under the furnace by a structural strut. To this strut is attached a second strut, extending back into the furnace pit, and furnished with a rack which engages the operating gears. The gears are operated by a motor, the controller of which is placed at the front of the furnace platform. An arrangement is made so that in the event of the tilting motor getting out of order, the gears can be operated by hand. The tilting mechanism requires a minimum depth of pit, the inside of the pit being only 7 feet below the charging platform. To entirely empty the furnace of steel, it requires a maximum tilting motion of 30 deg.

The electrode clamps also are of an improved construction. Each clamp consists of three segments, one of which is bolted to the center or main frame solidly, while the other two are pivoted on outside frames, one on each side of the main frame. The outside frames are in turn pivoted on the main frame. This allows of clamping or releasing the electrode by turning a lever at the edge of the furnace and does away with the necessity of the operator climbing on the furnace roof. By pivoting two of the segments, a play is secured that will tend to take up any inaccuracy in the diameter of the electrodes. The clamps are 16 inches in length and give a long bearing on the electrode that minimizes the tendency for electrodes to

crack off or heat at this point. Each segment of the electrode clamp is water-cooled.

It should be pointed out that, in the furnace illustrated herewith, three 6-inch Stackpole electrodes are used in each electrode clamp. This makeshift is necessitated by delay in securing electrodes of size sufficient to carry the current. As soon as standard 10-inch Stackpole electrodes can be obtained, one of these will replace in each clamp the three 6-inch electrodes now being used.

The electrode holders are of rugged construction, each being capable of holding 10 tons at the end. The holders run in guideways with a roller arrangement that makes a smooth and unimpaired operation possible. Magnetic circuits are broken up by a special construction.

It will also be noted in the accompanying illustrations that no electrode water-cooling collars are shown in the roof, due to the fact that the temporary arrangement of three electrodes in each holder is used, and it has been found difficult to make a practical collar under the circumstances. The design of the furnace calls for a special type of electrode collar, which fits around each electrode, extending well down into the roof brick, providing further protection for both the electrodes and the roof arch at this point. Differing from other types of electric furnaces, the Booth-Hall furnace has provided, not only water-cooling collars around the electrodes, but water-cooling in the electrode clamps themselves, as already mentioned in the foregoing paragraph; and valves in the piping system are so arranged that it is practical to shut off the water from any portion of the cooling area, depending on the type of service for which the furnace is used. An important point has been to provide water-cooling in all places where it can be used to best advantage, so that the furnace operator can cool those portions of the furnace which, for his work, are most exposed to the heat. It should also be noted that water-cooling pipes have been placed around the

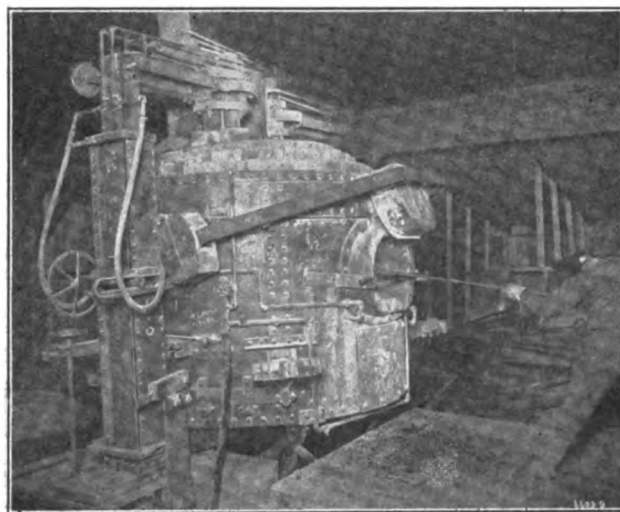


Fig. 2—Showing door for charging and slagging.

door jamb, which greatly lengthens the life of the refractories at this point.

Furnace designers differ on the use of water-cooling, but it has been the experience of the engineers of the Booth-Hall Company that ample facilities should be provided for such cooling, so that operators can use their own judgment as to what extent it shall be used for their type of steel work. Due to the difficulty in getting proper supplies of refractory materials and electrodes, the use of water-cooling has frequently permitted electric furnaces to keep in operation until additional supplies could be obtained and furnace kept in service, where otherwise they would be shut down, and the costs, due to such time out, would be much greater than the small additional amount of heat which is absorbed by the water-cooling.

The switchboard for operating Booth-Hall furnaces is usually furnished with a watt-hour meter, or two voltmeters and two ammeters, one for each electrode. The Terre Haute furnace is also furnished with an indicating wattmeter and power-factor meter. The special voltage-reduction switch which was developed for use with these furnaces is a simple device; it consists of six single-pole, double-throw knife switches, mounted together and operated by one lever. This switch is interlocking with the furnace oil circuit breaker, so that the switch cannot be thrown under load.

The furnace described in this article has been used to manufacture both high grade basic carbon steel and low phosphorus pig iron. The steel has been made with a carbon content as low as .07. Analysis ranging from dead soft steel to pig iron have been produced with phosphorus and sulphur running from .01 to .04, depending on the analysis desired. In reducing the phosphorus, an oxidizing lime slag is formed. This slag is then removed and a new lime slag formed to remove the sulphur. This slag is made reducing by throwing on top a quantity of powdered coke or anthracite coal. A dead white desulphurizing

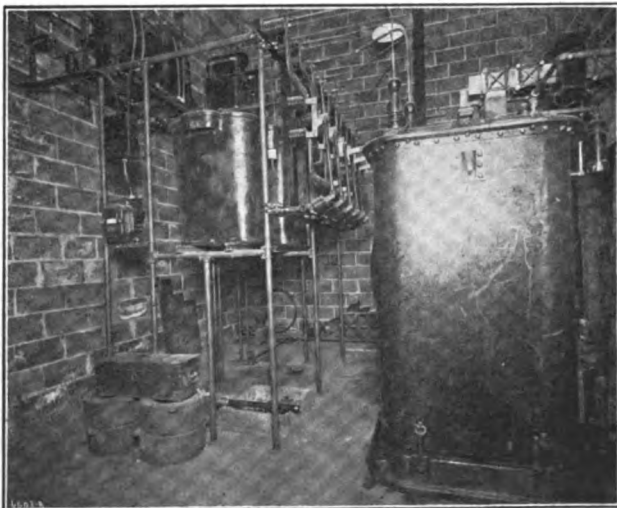


Fig. 3—Substation for electric furnace.

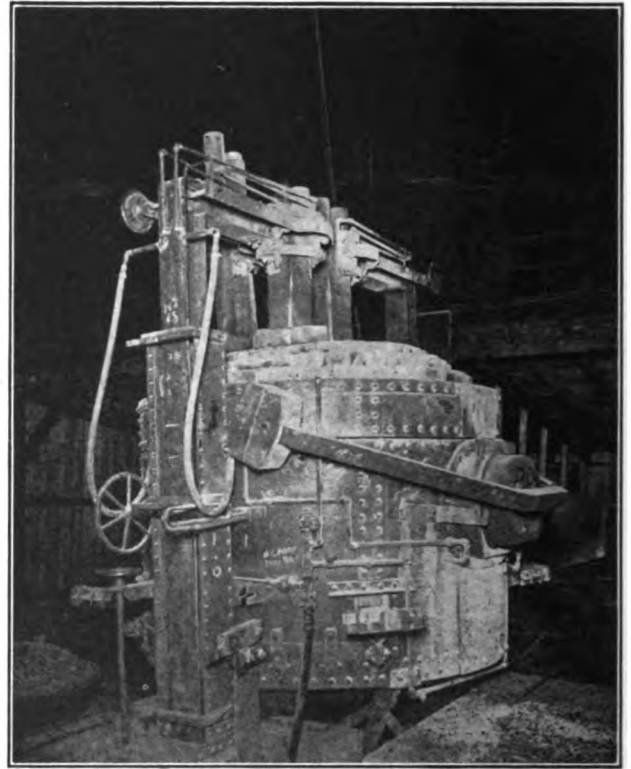


Fig. 4—Furnace door.

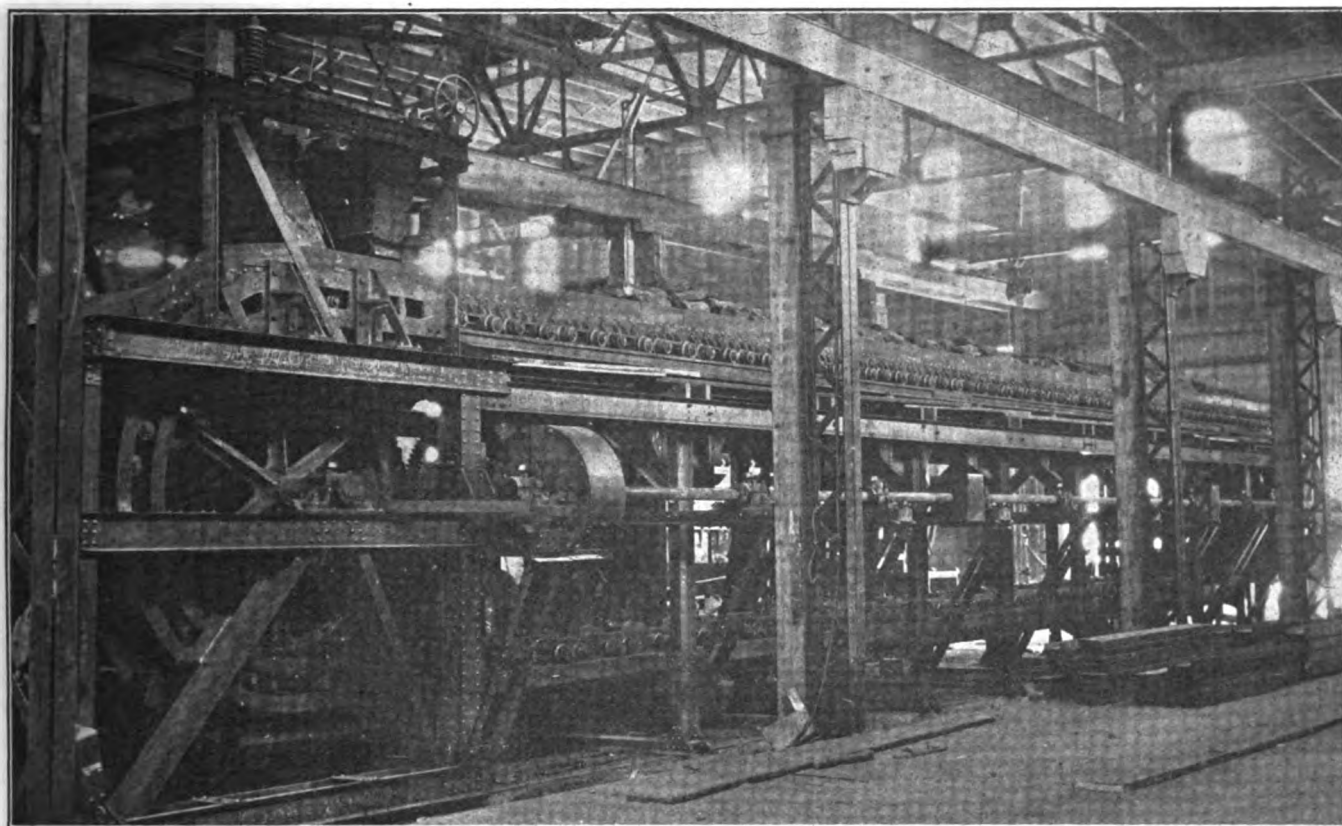
slag is obtained and held until the sulphur has been reduced to the desired limits. Under ordinary circumstances, it is not necessary to reduce the voltage, as the power input is readily controlled by the electrode regulators. If a super-refined steel is desired, the voltage and power are reduced by the voltage-reduction switch and the refining carried to any desired extent, the heat being held at such a temperature as not to injure the lining.

Booth-Hall furnaces are quick melters. The power input per ton of holding capacity is greater than other types of electric furnace. This increases the output per ton of holding capacity and shortens the melting-down period to a minimum.

The starting of this furnace in December completes a very remarkable record, especially in these abnormal times. The Booth-Hall Company was not formed until the latter part of June, 1917, and in the ensuing period the designs were perfected, the furnace built, installed and placed in operation. In the same period similar furnaces of other capacities have been contracted for, designed, built and are now in process of installation. Booth-Hall furnaces are built in the following sizes:

Holding capacity	Kva	Phase
1,500 to 2,000 pounds	300	One or two
3,000 to 4,000 pounds	600	One or two
3 to 5 tons	1,200	One or two
6 to 8 tons	1,800	Two or three
10 to 12 tons	3,000	Three

William K. Booth, the patentee and designer of the furnace, is a graduate of Ohio State University, and has been identified for several years with the Snyder Electric Furnace Company.



New Dwight and Lloyd Sintering Machine

American Ore Reclamation Company Builds Sintering Machine for Carnegie Steel Company Which Has Two and One-quarter Times the Capacity of the Present Standard Type.

A new and improved design of the Dwight and Lloyd sintering machine, which is shown in the above illustration, was recently completed for the Carnegie Steel Company, New Castle, Pa., and is to be used there for sintering blast furnace flue dust. This new machine has an active grate surface 42 inches wide and 57 feet 4 inches long and a sintering capacity two and one-quarter times that of the present standard Dwight and Lloyd machine.

This new large sintering machine contains a number of important improvements which are the result of the experience gained by the American Ore Reclamation Company in the operation of the many standard Dwight and Lloyd sintering machines which have been installed in plants in the last six years.

The standard Dwight and Lloyd machine heretofore used has an active grate surface 42 inches wide and 25 feet 6 inches long, and the lower strand of pallets rolls by gravity along an inclined track back to the driving sprocket wheels. The much greater length of the new machine makes the use of a gravity return undesirable and the lower strand of pallets is, therefore, positively driven along the lower track by

sprocket wheels at the discharge end, as shown in Fig. 1. These discharge end sprocket wheels are driven in synchronism with the driving end sprocket wheels, as shown in the illustration above the head line. This synchronous drive insures that the empty pallets are returned to the driving sprocket wheels at the same rate of speed as that of the pallets on the upper strand.

On this new large machine, sliding friction between the pallets and the wind box tops is eliminated by carrying the weight of the loaded pallets on wheels running on rails. The pallet wheels are fitted with renewable Shelby steel bushings and have large oil spaces that carry a month's supply of grease. The sprocket wheel teeth drive against tooth surfaces cast in the frame of the pallet and not against the pallet wheels, thus allowing the pallet wheels to properly perform their rolling function around the curved tracks at the drive end.

All of the gears and the sprocket wheel teeth on the new machine are made of steel castings. All gears and the shaft couplings are wholly enclosed in heavy sheet steel housings. The sprocket wheel teeth are removable and are machined in jigs, so that they are

interchangeable, and when worn may be replaced without tearing down the larger members of the drive. The driving pulley is fitted with a cast-iron break pin to prevent accidental injury to the driving mechanism.

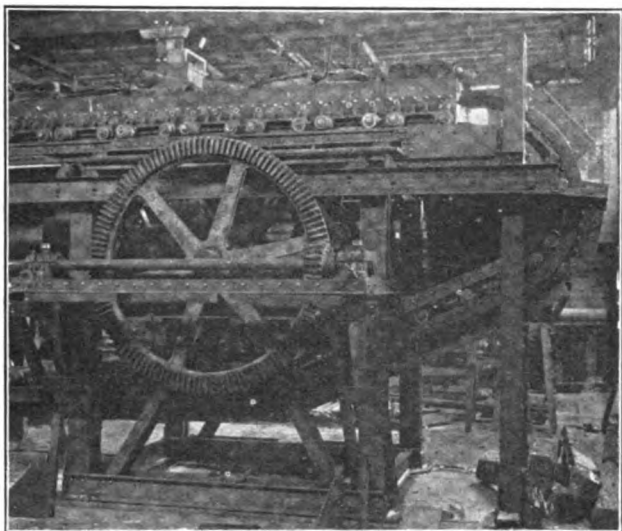


Fig. 1—Discharge end.

An important feature of the new machine is the use of seal bars on the pallets, which automatically maintain airtight joints between the pallets and the tops of the wind boxes. These seal bars are made very light and by their own weight bear on the finished surfaces of the wind box tops, and also fit against the finished sides of the pallet slots in which the bars are hung.

The first one of the new machines was thoroughly tested under full-load conditions which were obtained by loading the upper strand of pallets with 20 tons of pig iron, as shown in the illustrations. In all of the tests the machine ran with a notable degree of smoothness and the seal bars made a tight joint. The hp readings taken during the tests show that the various improvements have been fully effective in reducing the driving load. The fully loaded machine as set up for the test required $12\frac{3}{4}$ hp.

Based on the performance of the smaller machines now in service, the capacity of the new large machine, when sintering various materials, is as follows:

Flue dust	300 to 350 tons sinter per day of 24 hrs.
Pyrites cinder	375 to 450 tons sinter per day of 24 hrs.
Magnetic concentrates ..	450 to 550 tons sinter per day of 24 hrs.

Duplicates of this large sintering machine have been ordered from the American Ore Reclamation Company for installation in the following plants:

- Colorado Fuel & Iron Co., Pueblo, Col.
(To treat ore concentrates mixed with blast furnace flue dust.)
- E. & G. Brooke Iron Co., Birdsboro, Pa.
(To treat magnetic concentrates.)
- Davison Chemical Company, Curtis Bay, Md.
(To treat pyrites cinder.)
- American Steel & Wire Co., Donora, Pa.
(To treat blast furnace flue dust.)

In connection with this description it is interesting to note the remarks made by Barret and Rogerson

before the British Iron and Steel Institute at the last fall meeting. Referring to the Dwight and Lloyd system in general, the paper reads as follows:

"The system and machinery are simple and well adapted to the prompt correction of any irregularities, for the material is open to inspection the whole time, and the effect of any adjustment in the mixture, ignition, speed, or suction can be observed almost immediately, and if necessary, in theory at least, corrected before any large quantity of unsuitable product has been made.

"Notwithstanding this great advantage, however, it appears that primarily everything depends on the thorough preliminary mixing of the raw materials to ensure regularity in the resulting sinter, and in the various descriptions of this process there are many indications that prevention is vastly superior to cure in this connection.

"The suction required is from 10 to 17 inches of water, and the volume of gases exhausted was stated to be about 52 cubic feet per minute per square foot of grate area in plants described in 1915.

"In a recent description of a new and very complete plant installed at Mingo Junction, O., it is stated that a machine having a grate area of about 93 square feet produces 300 tons per day when working flue dust. In this case a fan coupled to a 115 hp motor and

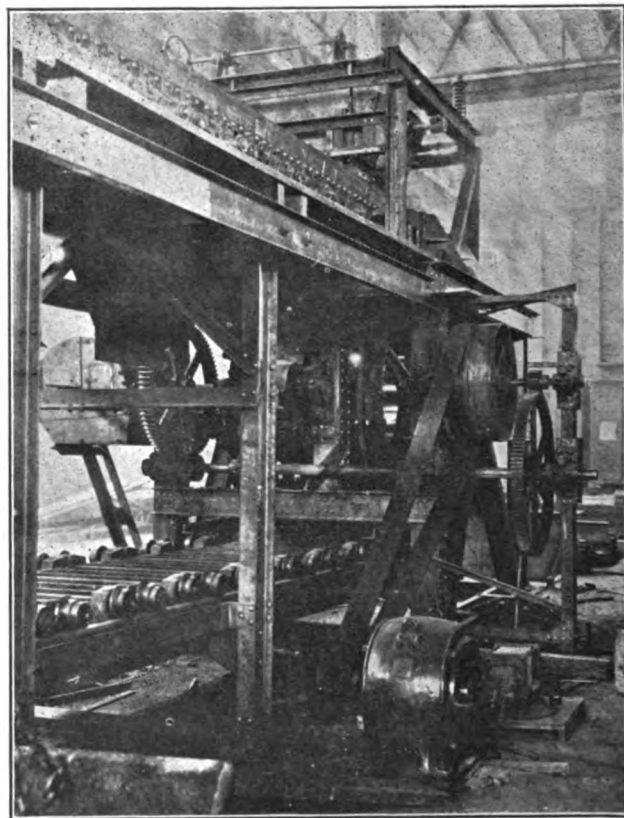


Fig. 2—Drive end.

capable of exhausting 25,000 cubic feet of exhaust gases per minute is provided, which represents approximately 270 cubic feet of gases per square foot of grate area per minute."

Problems of Hot Blast Stove Design

Computations and Analysis of Hot Blast Stove Design Based on Operative Results—Necessity of Sufficient Storage Capacity Shown — Off Gas Heat Capacity Curves Plotted.

By A. D. WILLIAMS.

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Hot blast stoves have been built with two, three and four passes and with central and side combustion chambers. The purpose of this apparatus is to transfer the heat generated by the combustion of blast furnace gas to the air used in blowing the furnace. The earliest stoves, before the advent of the closed-top furnace, were fired with solid fuel. Then, for a time the only uses for the furnace gas were in heating the blast and generating a portion of the steam used at the plant. The advance in blast furnace practice now demands a high blast temperature. In addition there are many demands for plant power, and where the blast furnace serves a steel plant, there is an outside demand for power. Hence there is a profitable use for all of the gas that can be made available by reducing the fuel consumption of the stoves.

Before the days of gas cleaners and washers, the gas as burnt, contained a large amount of entrained dust, portions of which had a tendency, when at a high temperature, of combining with the constituents of the brick. As a result, the hottest portion of the checkerwork rapidly lost efficiency and checker openings were plugged. With practically clean gas, however, the stove problem reduces to:

1. The economical combustion of the gas.
2. The absorption and giving off of the heat generated.
3. The conservation of the heat.

This last is a double problem, one of heat insulation and the reduction of stack or off gas temperatures.

At one time the radiation and conduction losses from the shell of a stove were dismissed with a rough guess that they amounted to 10 per cent of the heat generated. Later observations showed these losses had been under-estimated and have resulted in filling the air space between the brick and the shell with infusorial earth or other heat insulation.

The reduction of the off gas heat loss has certain limitations. The cold blast reaches the stove at a temperature between 70 and 100 deg.; therefore, the off gas must leave the stove at approximately 200 deg. in order to provide a sufficient heat differential at the low temperature end of the checkers. This temperature of off gas is too low for economical regeneration, although it is sufficient to furnish chimney draft to carry off the waste gases.

Fig. 1 gives the heat capacity of the off gases resulting from the combustion of a blast furnace gas of the following composition:

H ₂	3.92
Co	23.95
O ₂	00.39
CO ₂	12.96
H ₂ O	1.65
N ₂	57.13
	100.00

This gas has a thermal value of 1,864 calories per 100 molecular volumes, or 837 calories per cubic meter.

Curves have been plotted by the method of Mallard

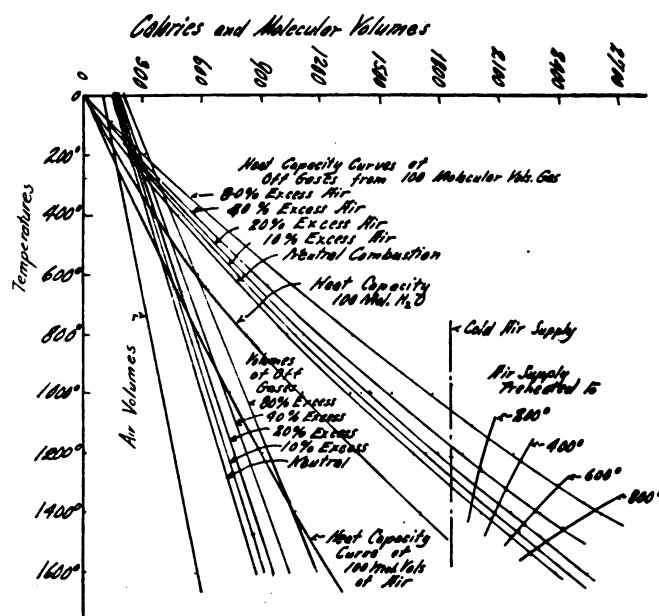


Fig. 1—Heat capacity of the off gases resulting from the combustion of a blast furnace gas.

and Le Chatelier, giving the heat capacity of the off gases resulting from the combustion of this gas with the theoretical amount of air and with excess air supplies of 10, 20, 40 and 80 per cent. These curves are plotted with coördinates of temperature and calories per 100 molecular volumes. A straight line with an ordinate of 1,864 calories intersects these curves and gives the theoretical flame temperatures obtainable, while above this a second series of curves intersect the heat capacity curves, giving the theoretical flame temperatures obtainable with the air supply preheated to different temperatures.

TABLE OF THEORETICAL FLAME TEMPERATURES.

Combustion with Theoretical air sup- ply	Temperature of air supply				
	0°	200°	400°	600°	800°
10% Excess air...	1,310°	1,370°	1,420°	1,480°	1,535°
20% Excess air...	1,270°	1,340°	1,390°	1,460°	1,515°
40% Excess air...	1,230°	1,310°	1,365°	1,435°	1,490°
80% Excess air...	1,170°	1,258°	1,315°	1,390°	1,455°
100% Excess air...	1,050°	1,150°	1,220°	1,310°	1,385°

Calories Released by Combustion.

Combustion with Theoretical air sup- ply	Temperature of air supply				
	0°	200°	400°	600°	800°
10% Excess air...	1,864°	1,958°	2,055°	2,156°	2,259°
20% Excess air...	1,864°	1,968°	2,075°	2,187°	2,299°
40% Excess air...	1,864°	1,978°	2,095°	2,216°	2,341°
80% Excess air...	1,864°	1,997°	2,135°	2,276°	2,421°
100% Excess air...	1,864°	2,036°	2,212°	2,394°	2,584°

(Note—All temperatures in this article in Cent. deg.)

These curves show that the gain in combustion temperature by preheating the air supply will be at the expense of a higher off gas temperature from the stove. This preheating cannot be obtained without additional checker work outside of the stove. Further, it is necessary to dispose of the waste gases in some manner that will remove them to a point where they will not be a nuisance to the plant or its neighbors. If their temperature is reduced much below 200 deg. it will become necessary to add a fan with its motive power to the equipment. With gas of the composition given and a stack temperature averaging 200 deg., the heat carried away will range between 225 and 300 calories per 100 molecular volumes of gas burned, or from 12 to 16 per cent.

Some tests* have been made and published covering the operative results with a two-pass side combustion stove and the following computations and analysis is based upon the figures given. A few of the dimensions used and given in Fig. 2 were derived by proportion and, therefore, may not be minutely accurate. All of the computations have been made by the slide rule and lack the accuracy obtainable by the use of seven place logarithms. With these apologies they are presented.

In the stove under consideration, the gas burner was located on a radial line, passing through the minor axis of the combustion chamber. The axial line of the burner being horizontal.

Burner area = 0 m² 107.

Gas pressure in main = 68 m/m of water.

Gas burned = 2 m³ 68 per second.

Velocity of gas through burner = $2.68 \div 0.107 = 25$ m 10 per sec.

The head required for this velocity:

$h = v^2 \div 2g = 32$ m 00 of the gas = 41.0 m/m of water.

Difference between pressure in main and velocity pressure:

$68 - 41.0 = 27.0$ m/m of water.

As there are a number of bends between the burner outlet and the gas main, it is probable that this pressure will be absorbed in overcoming their re-

* Paper by A. E. Maccoun, read before American Iron and Steel Institute, May 28, 1916.

sistance. In computing the foregoing, no allowance was made for the fact that the burner nozzle becomes heated, and this might result in an increase in the volume of the gas and its velocity.

The combustion chamber in this stove was ellip-

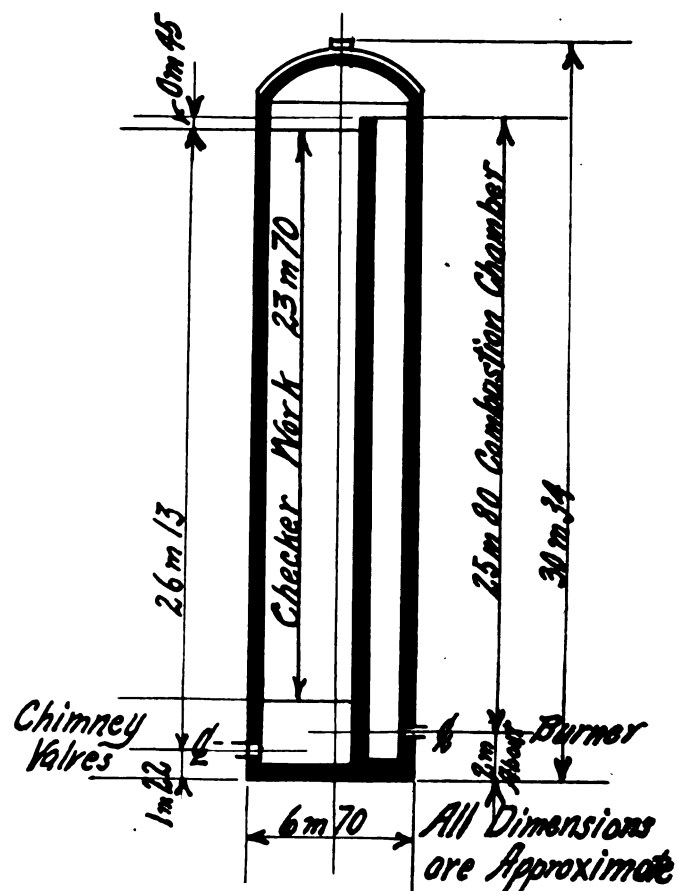


Fig. 2—Heating surface 4,780 m²m checkers. About 330—150 × 150 m/m checker openings = 7 m² 70 area. Walls 75 m/m. 1 Burner 0 m² 107 area. 3 Chimney valves 0 m 52 = 0 m² 212 area. Combustion chamber—Ellipse 3 m 35 × 1 m 50 = 3 m² 93 area.

tical in shape, having a major axis of 3 m 35 and a minor axis of 1 m 50, making its area = 3 m² 94. Its height, above the burner axis was about 25 m 80, making its total volume 102 m³. In making the test on the stove, temperatures were taken at various heights in the combustion chamber as shown in Fig. 3. The average temperature in the combustion chamber was 1,126 deg. As the specific weight of the gases of combustion and the gas burned are very close to that of air, the computation has been simplified by making the assumption they are equal to air. On this basis the weight of the off gases will be:

Specific weight of off gases at 1,126 deg.

$$= \frac{1.29}{1 + \frac{1,126}{273}} = 0 \text{ kg } 252 \text{ per cubic meter.}$$

A column of gas of this weight the full height of the combustion chamber would exert an upward pressure at the top of:

$$\begin{aligned}\text{Upward pressure} &= 25.80 (1.29 - 0.252) \\ &= 26 \text{ kg } 70 \text{ per sq. meter.} \\ &= 26.7 \text{ m/m of water.}\end{aligned}$$

This upward pressure, if not balanced at the dome of the stove, would create a depression at the burner level.

The checkerwork has an approximate height of 23 m 70 and the height from the chimney valve to the top of the combustion chamber is 26 m 58. The temperature of the gases at the top of the checkerwork is 1,000 deg. and at the chimney valve it averaged 276 deg. This gives an average temperature for the gases of combustion in the checkerwork of 0.5 (1,000 + 276) = 638 deg.

Specific weight of off gas at 638 deg.

$$= \frac{1.29}{1 + \frac{638}{273}} = 0 \text{ kg } 386 \text{ per cubic meter.}$$

A column of gas of this weight would exert an upward pressure of:

$$\begin{aligned}\text{Upward pressure} &= 26.58 (1.29 - 0.386) \\ &= 23 \text{ kg } 95 \text{ per sq. meter.} \\ &= 24 \text{ m/m of water.}\end{aligned}$$

	m/m of water.
Upward pressure in combustion chamber.....	26.7
Upward pressure in checker chamber.....	24.0
Difference or positive pressure at chimney valve	2.7
The draft depression measured at the chimney valve was	37.0
Therefore the draft at the chimney value due to the stack was.....	34.3
Upward pressure in checker chamber.....	24.0
Depression due to draft in dome.....	10.3
Upward pressure in combustion chamber.....	26.7
Draft depression at burner.....	37.0

This draft depression is sufficient to draw in the air at the burning opening.

The volume of gas burned per second:

$$2.68 \div 0.02232 = 120 \text{ molecular volumes.}$$

With 40 per cent excess the air required will be:

$$95.75 \times 1.20 = 115 \text{ molecular volumes.}$$

$$115 \times 0.02232 = 2 \text{ m}^3 56.$$

The off gases of combustion will be:

$$182 \times 1.20 = 219 \text{ molecular volumes.}$$

$$219 \times 0.02232 = 4 \text{ m}^3 89.$$

At the average temperature of the combustion chamber the volume of the off gases will be:

$$\text{Volume at } 1,126^\circ = 4.89 \left(1 + \frac{1,126}{273}\right) = 25 \text{ m}^3 05.$$

The velocity head of this column of hot gas will be:

$$h \text{ at } 1,126^\circ = 25.80 \frac{1.29 - 0.252}{0.252} = 106 \text{ m } 00.$$

The ascension velocity due to this head will be:

$$v = \sqrt{2g \times 106} = 45 \text{ m } 70 \text{ per second}$$

The average area of the column of hot gases will be:

$$25.05 \div 45.70 = 0 \text{ m}^2 547.$$

The area of the combustion chamber is 3 m² 94; therefore, this column of flame passes up through it in much the same way that the hot gases pass up a chimney that is very much too large for the volume carried. The balance of the area of the combustion chamber will be occupied by eddy currents of gases slightly cooler than the column of flame. The flame will be drawn out and lengthened, and combustion will only be completed after it has reached the dome of the stove. In stoves where the volume of space in the dome is insufficient to hold the quantity of unburnt gases until they are consumed, these gases will be carried down into the checkers. The turn into the dome causes a remixing of the gases that accelerates combustion.

One of the arguments that will be advanced to show that the action claimed above is impossible, is that a plume of flame comes out of the burner door

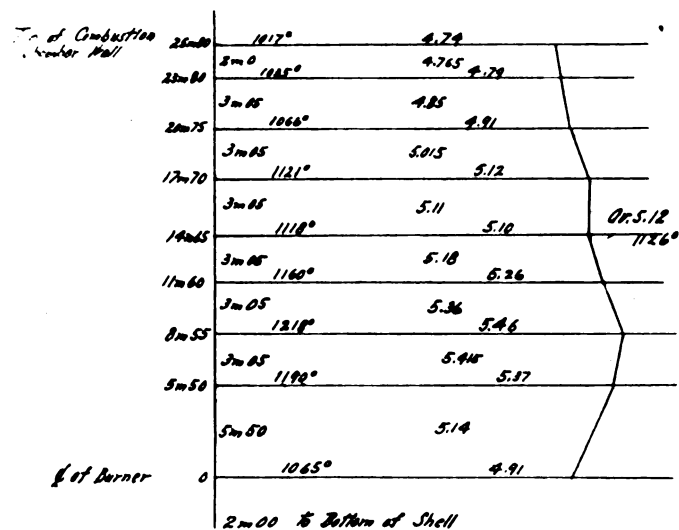


Fig. 3—Temperatures in combustion chamber.

around the burner nozzle. The reason for this flame is very simple. The furnace gas jets out of the nozzle with a velocity of 25 meters per second, directed across the minor diameter of the combustion chamber and smashes into the wall. This causes the current of gas to mushroom out all around the jet and some of it very naturally reverses and flows back far enough to flame out of the door, as its short stay in the combustion chamber has sufficed to raise it to the ignition temperature. If there was not a considerable draft depression in the combustion chamber a great deal more gas would be wasted in this manner.

This mushrooming, coupled with the large area of the combustion chamber and the imperfect mixing, is the cause of the explosive burning of the gas. A portion of the gas rises to form the flame column occupying a portion of the combustion chamber. Other portions of the gas become detached and float into the eddies surrounding the main jet of flame where they meet free oxygen, as soon as an explosive mixture form it detonates. This forces a jet of flame out at

the burner, resulting in a momentary interruption of the air supply followed by the sucking in of an excess air supply. The frequency of these explosions and their violence will depend, in part, upon the mixing that takes place at the burner door and the height of the combustion chamber; this last governing the height of the column set in vibration. With poor mixing these explosions will be at longer intervals and more violent. As the mixing of the gas and air at the burner is improved the frequency of the explosions will increase and their violence will decrease. The vibrations from these explosions cause waves in the gas main. With a very thorough mixing of the air and gas supply the frequency of these explosions may be greatly increased. These explosions cannot be entirely eliminated in stoves having a considerable area of combustion chamber the full height of the stove.

The side or center combustion chamber stove may be readily altered to secure better combustion conditions by installing a baffle arch across the combustion chamber, pierced with openings so proportioned that the gas flow is retarded and combustion takes place and is practically completed below the arch. The height of this arch above the burner will depend upon the quantity of gas to be burned and the time required to burn it. The time required for combustion will be about two seconds. The size of the openings in the arch will be determined by the height of the combustion chamber below the arch. The size of this chamber and the vent opening may be arrived at in the following manner:

$$\text{Chamber volume} = 25.05 \times 2 = 50 \text{ m}^3 10.$$

$$\text{Height of chamber} = 50.10 \div 3.94 = 12 \text{ m } 70.$$

The size of the opening may be determined by Yesmann's formula:

$$Q = k'k'' s \sqrt{2g H \frac{P_{\text{air}} - P_{\text{gas}}}{P_{\text{gas}}}}$$

In which:

Q = Quantity of gas flowing per second, cubic meters.

s = Area of opening in square meters.

$2g = 2 \times 9.81 = 19.62$ (gravitation constant).

H = Distance from top of chamber to lower surface of gas.

$P_{\text{air}} = 1.29$ kg. weight of air per cubic meter.

P_{gas} = Specific weight of gas at combustion chamber temperature. (In this case P_{gas} 1,126 deg. = 0.252 kg. per cubic meter.)

k' = Coefficient of contraction of the gas current.

k'' = Coefficient of velocity. (That is the ratio between the real velocity at the point of maximum contraction and the theoretical velocity.)

Inserting values in the equation:

$$50.10 = k'k'' s \sqrt{19.62 \times 12.70 \frac{1.29 - 0.252}{0.252}}$$

From which:

$$k'k'' s = 1.57.$$

Definite values of the coefficients k' and k'' have

not been established for gas; but unless the openings are very small and have thin sharp edges, they will be close to unity. In this case the opening will not have thin edges as the arch over the combustion chamber will have an appreciable thickness for construction reasons; further, the opening is fairly large. In fact, it might be desirable to divide the opening. Assuming these coefficients are unity in this case, the value of $s = 1 \text{ m}^2 57$.

Occasional experiments have been made in placing checkerwork in the upper portion of the combustion chamber. Such checkerwork is not only efficient, as the gases circulate in the wrong direction, but is exposed to a high temperature which causes it to combine with the fine flue dust, and this results in rapid destruction of the supporting arches. A thick heavy arch, however, resists such influences better.

In the stove which was tested, the chimney gases had an average temperature of 276 deg. at the valve and the draft, measured at the same point, averaged 37 m/m of water. There were three chimney valves, each having an area of 0 m² 212.

The volume of the off gases at 276 deg.

$$= 4.89 \left(1 + \frac{276}{273}\right) = 9 \text{ m}^3 80.$$

With three chimney valves the average gas velocity will be:

$$\frac{9.80}{3 \times 0.212} = 15 \text{ m } 40 \text{ per second.}$$

With two chimney valves the average gas velocity will be:

$$\frac{9.80}{2 = 0.212} = 23 \text{ m } 20 \text{ per second.}$$

The velocity head with three valves will be:

$$\frac{15.40^2}{2 \times 9.81} \times \frac{1.29}{1 + \frac{276}{273}} = 7 \text{ kg. } 70 \text{ per square meter} = 7.70 \text{ m/m of water.}$$

The velocity head with two valves will be:

$$\frac{23.20^2}{2 \times 9.81} \times \frac{1.29}{1 + \frac{276}{273}} = 17 \text{ kg. } 80 \text{ per square meter} = 17.8 \text{ m/m of water.}$$

These high velocities through the chimney valve indicate these valves are too small. With the three valves about 20 per cent of the stack draft is consumed in increasing the velocity of the gases through the valve; while with two valves about 50 per cent of the draft is consumed in this manner.

A stove is operated in a continuous cycle during its life. Each cycle being made up of two change periods; a gas period and an air period. The stove tested was apparently operated on the following cycle:

Change period	6 min.	360 sec.
Gas or heating period.....	168 min.	10,080 sec.
Change period	6 min.	360 sec.
Air or cooling period.....	60 min.	3,600 sec.
Time for complete cycle.....	240 min.	or 4 hours.

Ratio of time on air to time on gas = 60 : 168
= 1.00 : 2.80.

The total heating surface in the stove was 4,780 square meters in the checkers with a height of approximately 23 m 70. The checker openings were 150 m/m square with walls 75 m/m thick, with a total brick volume of 224 cubic meters weighing 403,200 kg.

The temperature of the gases of combustion at the top of the checkerwork is about 1,000 deg. and at the chimney valve 276 deg.

Heat capacity of off gases per second at 1,000 deg. = $1,440 \times 1.20 =$	2,080 cal.
Heat capacity of off gases per second at 276 deg. = $390 \times 1.20 =$	468 cal.

Heat absorbed by checkerwork by difference =	1,612 cal.
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In one cycle:

Calories released by combustion of gas =	22,548,960
Calories carried off in chimney gas =	4,717,440

Calories available in stove =	17,831,520
Calories absorbed by checkerwork	16,248,960
Calories carried away by hot blast	12,173,400
Calories lost by radiation, changes, etc.	5,658,120
Total heat loss	10,375,560

Probably 99 per cent of the heat carried away by the hot blast is abstracted from the checkerwork = calories..... 12,051,666

The specific heat of the brickwork is about 0.25 and on this basis the amount of heat required to

change the temperature of the brickwork one degree will be:

$$403,200 \times 0.25 = 100,800 \text{ calories.}$$

The heat absorbed by the checkerwork is therefore sufficient to raise its temperature:

$$16,248,960 \div 100,800 = 162 \text{ deg.}$$

While the heat carried off by the hot blast would be sufficient to cause a temperature drop of:

$$12,051,666 \div 100,800 = 119 \text{ deg.}$$

On a percentage basis:

The heat carried away by the hot blast is	54% of the total.
The heat lost from all causes is	46% of the total.
The stack loss is	21% of the total.

The stack loss might be reduced somewhat by a reduced temperature of chimney gases.

One feature in checkerwork design is the necessity of providing not only sufficient heating surface, but of providing enough brickwork to store the heat absorbed. When there is a deficiency in heat storage capacity heat will be carried away from the hotter portions by conduction, and as the heat gradient to the outer walls is greater than to adjacent portion of the checkerwork, a considerable proportion of the heat will be carried to them and lost, unless the outside of the stove is well insulated. This loss will naturally be greatest at the high temperature end of the checkerwork. The chimney gas temperature will be high.

A.I.S.E.E. Committees and Convention Date

Society Has Shown Remarkable Growth During Past Year—New Administration Effective Since January—September Annual Convention Date Decided—To Be Held in Baltimore or New York

The Association of Iron and Steel Electrical Engineers have recently announced the new officers of the association and the chairmen of the various committees. The officers, the majority of which were elected at the last annual meeting held in Philadelphia, are:

C. A. Menk, president, Carnegie Steel Company, Munhall, Pa.; D. M. Petty, first vice president, Bethlehem Steel Company, South Bethlehem, Pa.; B. W. Gilson, second vice president, Carnegie Steel Company, Youngstown, O.; J. F. Kelly, secretary, National Tube Company, McKeesport, Pa.; James Farrington, Treasurer, LaBelle Iron Works, Steubenville, O.; F. D. Egan, past president, Pittsburgh Iron & Steel Foundries Company, Midland, Pa.; W. T. Snyder, past president, National Tube Company, McKeesport, Pa.

Under the management of the previous administration the membership increased by 237 members during the last year. The annual convention held at Philadelphia exceeded all past conventions from a standpoint of the technical discussions. It is interesting to note that this society first organized in 1908, and five years after this the National Safety Council developed from one of the committees of the A. I. S. E. E. The annual meetings have been held in the following order:

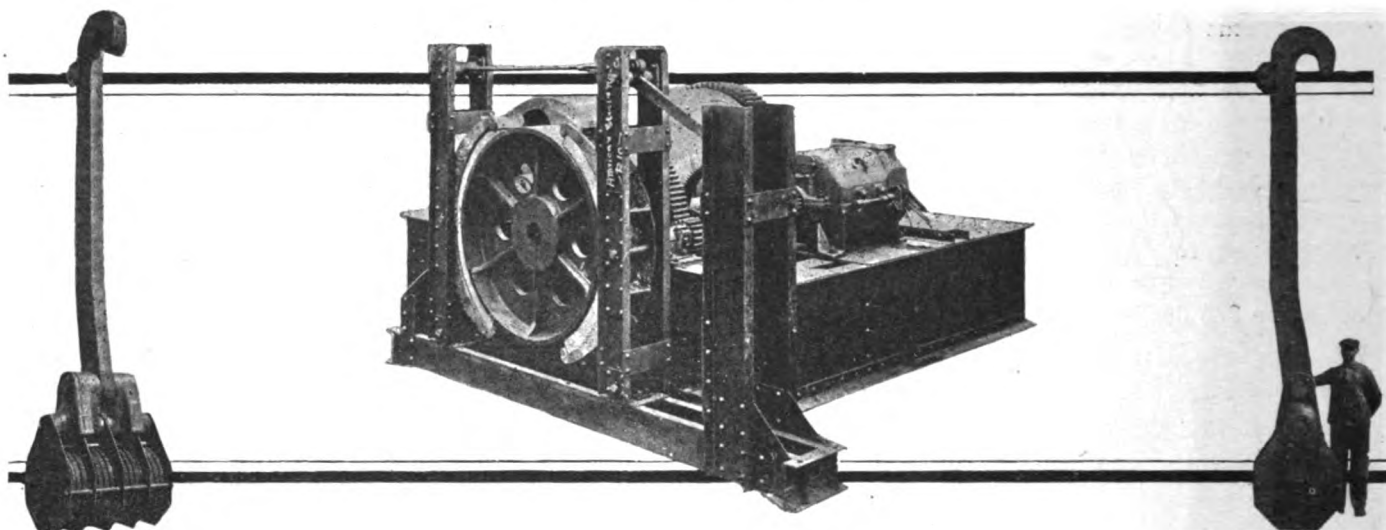
1908 Organized with James Farrington as president; 1909 Buffalo, president, J. C. Reed; 1910 Pittsburgh, president, F.

P. Townsend; 1911 New York, president, L. W. Palmer; 1912 Milwaukee, president, Barton R. Shover; 1913 New York, president, C. W. Parkhurst; 1914 Cleveland, president, E. Friedlander; 1915 Detroit, president, O. R. Jones; 1916, Chicago, president, W. T. Snyder; 1917 Philadelphia, president, F. D. Egan.

For the ensuing year the following members will act as chairman of the respective committees:

W. T. Snyder, chairman Standardization Committee, National Tube Company, McKeesport, Pa.; W. O. Oschman, chairman Power Committee, Oliver Iron & Steel Company, Pittsburgh, Pa.; A. H. Swartz, chairman Publicity and Promotion Committee, Westinghouse Electric & Manufacturing Company, 1808 Union Bank Building, Pittsburgh, Pa.; K. H. Cederland, chairman Electric Furnace Committee, Duquesne steel works, Carnegie Steel Co., Duquesne, Pa.; J. F. Kelly, chairman Membership Committee, National Tube Company, McKeesport, Pa.; Walter Greenwood, chairman Safety Committee, Carnegie Steel Company, Ohio works, Waverly avenue, Youngstown, O.; B. W. Gilson, chairman Educational Committee, Carnegie Steel Company, Ohio works, Youngstown, O.; E. Friedlander, chairman Editing Committee, Carnegie Steel Company, Edgar Thomson works, Braddock, Pa.; A. H. Swartz, chairman Convention Committee, Westinghouse Electric & Manufacturing Company, 1808 Union Bank Building, Pittsburgh, Pa.; W. C. Kennedy, chairman Electrical Development Committee, Standard Seamless Tube Company, Ambridge, Pa.; F. D. Egan, chairman Finance Committee, Pittsburgh Iron & Steel Foundries Company, Midland, Pa.

The next annual convention will be held either in New York or Baltimore, September 9-13, 1918.



Unique Ladle Tilters at Casting Machine

Ladle-Tilting Mechanism Comprising Winding Rig, Special Hook and Block, Is Used for Pouring Sunday Iron Onto Pig Casting Machines at American Steel & Wire Co.'s Plants.

By H. V. SCHIEFER.

A number of ladle tilting mechanisms have recently been installed by the American Steel & Wire Co., at their Cleveland blast furnace plants that are unusual in design and application. They are used for tilting the ladles of molten iron onto pig casting machines and are used only on Sundays. During the week the hot metal from the furnaces is transferred to the mixer in the usual hot-metal cars, but since the blast furnaces run continuously and the mills do not, it is necessary to divert the molten iron from the furnaces to other channels. This surplus molten metal is sent to the pig casting machines.

The usual method of tilting ladles for pouring to casting machines was by the use of an overhead traveling crane, but this has its disadvantages inasmuch as a heavy building is required and an expensive crane operator has to be employed. To these disadvantages must be added an expensive crane equipped with a pair of heavy hooks that cannot be utilized for other purposes.

To overcome these disadvantages the equipment as installed is shown in Fig. 1. The winding rig is placed on the ground and a special hook and block is utilized, whose upper block is built into a pair of heavy roof

trusses. When not in use, the hook is drawn up between the roof trusses far enough so that the traveling crane in the building may pass freely under it. The entire equipment is made extremely rugged and fool-proof, with a two-fold object in view, viz: to handle molten iron with safety to workmen, and since the equipment is to be used once a week only it will naturally be neglected, hence it must practically take care of itself.

The ladles are of 50 tons' capacity which necessitates a heavy hook and blocks. To prevent the possibility of failure the hook is made up of a number of plates or laminations $\frac{1}{2}$ inch thick. These were cut from rolled plates with an oxy-acetylene torch and securely riveted together with 1 inch rivets driven hot, there being 11 laminations in a hook. This hook is attached to the bot-

tom block by means of an annealed steel casting socket. Onto this socket casting the sheaves of the bottom block are mounted. These sheaves are 16 in number, are of steel and scored for the hoisting cables. The bottom block, together with the socket and hook are 14 feet 11 inches long. All pins are provided with grease cups for the proper lubrication of all sliding contacts. The hook is shown on the extreme right

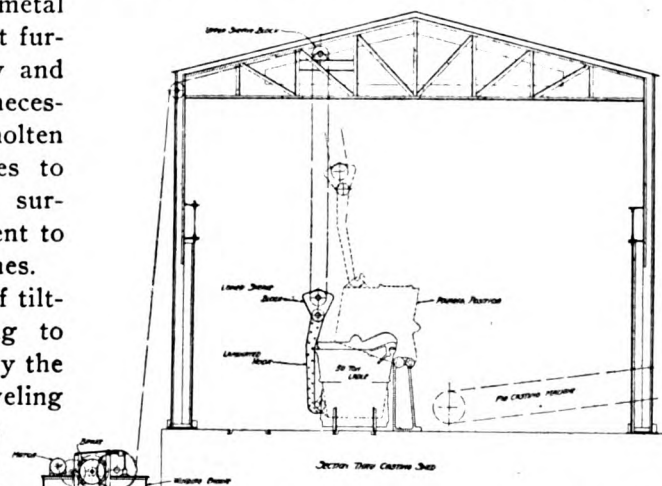


Fig. 1—Showing installation of ladle tilting mechanism.

and left of the illustration, just above the headline of this article.

Following the adopted policy of safety, there are two independent cables wound on the sheaves, making two separate 16-part lines, either one of which is capable of sustaining the load. The ropes are of steel and $\frac{3}{4}$ inch diameter. The upper block is similar to the bottom block with its 16 sheaves, excepting that it is supplied with an equilizer bar. This consists of a bell crank which is mounted on the same pin as the sheaves and is free to rotate. Onto the ends of this bell crank the ends of the two hoisting ropes are fastened; being free to turn, the ropes seek their equilibrium and the pull is the same on each. Thus the ropes when working normally have a very low working stress. In the event that one cable breaks the equilizer would simply rotate about 90 deg. and the remaining rope would pull on the pin through a dead center. From the upper blocks the ropes lead over a pair of sheaves, mounted in the roof trusses near the eaves, and are led down to the drum of the winding engine that is located at a convenient point on the ground.

The winding engine shown in the center of the illustration above the headline consists of a built-up structural steel base, set on a concrete foundation, on which are mounted the drum, shafts, motors and brakes. The operation of the winding engine is made automatic, so that it may be run by the cheapest kind of labor that is usually met with around the casting machines. The operation of the engine is controlled by means of a Cutler-Hammer automatic control so arranged that the hoisting speed when handling the ladle may vary from 6 to 36 inches per minute with load, and 10 feet per minute for empty hook at the will of the operator. When lowering, dynamic braking is utilized. To prevent overwinding there is provided

a normally closed limit switch arranged to be tripped from the hoisting block.

The structural steel frame is about 12 feet square and is made up of plate and angle girders 30 inches deep. The drum is 60 inches in diameter and 72 inches face and machined for the hoisting cable. This drum is mounted on an 8-inch hammered steel shaft and runs in bronze-bushed bearings. The first countershaft is 6 inches in diameter and is provided with a 57-inch cast steel brake. This brake is of the post type, common to large mine hoists. It is operated through a set of levers by a cast iron counterweight. As long as there is current in the line this counterweight is held up by an electric solenoid, holding the brake free from the brake wheel. If for any reason the power is interrupted the solenoid is immediately demagnetized and the counterweight drops, setting the brake. This brake is large enough to hold the maximum load on the hook.

The gearing between the drum which runs at 3 r.p.m., and the motor at 500 r.p.m. is of steel, the gears being cast steel and the pinions cut from forged blocks. The gears all run in oil-tight cast iron gear guards. The motor is a Westinghouse mill-type, $37\frac{1}{2}$ hp, compound-wound, 220 volts direct-current.

The armature shaft of the motor is extended and a General Electric shunt-wound brake is mounted thereon. This brake is similar in its functions to the one mounted on the first countershaft and is provided so that if the other brake does not work the ladle will not lower. The entirely satisfactory operation of the finished mechanisms has been a justification of the precautionary measure taken to prevent possibility of accidents.

The machines, three in number, two installed at Central furnaces and one at the Emma furnace, were built by the C. O. Bartlett & Snow Co., Cleveland, O.

Blast Furnace Slag Association Formed

Object of New Society to Promote and Stimulate the Use of Blast Furnace Slag, as Well as to Investigate and Develop Commercial Applications.

The National Slag Association was formed January 16, 1917, at Columbus, O. The following officers were elected: F. A. Sarstadt, Cleveland Macadam Company, president; C. L. Ireland, Birmingham Slag Company, vice president; H. J. Love, Standard Slag Company, secretary-treasurer. Temporary offices will be located at 707 Wick Building, Youngstown, O., and a permanent office to be located in Cleveland, O., will be established in the near future.

The objects of the society are as follows:
To promote and stimulate the use of blast furnace slag.

To investigate and exploit its technical



H. J. Love, Sec.-Treas.

merits in the fields where use has already been or may further be developed for the material.

To collect, classify and transmit to its members all data procurable which pertains to the present or possible uses of blast furnace slag.

To maintain an information and publicity department for the purpose of presenting to engineers, architects, contractors and others interested in work where slag may be utilized, authentic data that would aid in the accomplishment of the aims of the association.

To cooperate with other commercial associations, technical societies or laboratories.

Fuel Economies in Steel Mill Power Plant

Bettering Conditions by Building Up a Higher Standard of Intelligence in Boiler Room Operation—Recommendation to Place Technically Trained Men in Charge of Waste Elimination.

By JOSEPH G. WORKER.

Authorities have asserted that out of the production of 600,000,000 tons of coal in the United States in 1916, 25 per cent was wasted, amounting to \$500,000,000 a year. It is quite surprising to find that the coal consuming public does not dispute the statement. It is, therefore, evident that there is an immediate task before us, and those whose daily duties take them into this problem should coöperate to the fullest extent in eliminating this waste and obtaining the end desired.

There are many ways to attack this problem, but one plan stands out above all others—and that is the establishment of a better practice in the operation of fuel-burning equipment. What is needed is a strong movement towards bettering conditions and building up a higher standard of intelligence in boiler-room operation. It requires men of intelligence and good judgment to supervise fuel economy, and the end desired will never be attained as long as we hold the old idea that the requisites of good firing are brawn and a strong back.

This movement, without question, would have the support of all engineers who are daily active in this work, but what is required is the support of the executives, some of whom (and perhaps unconsciously) set the standard of intelligence in the boiler room, and, in a number of cases, this is done without full knowledge and facts of the economic necessity of boiler-room operators. Mechanical stoker equipment has not, and never can be, a substitute for intelligence and good judgment, and there are just as good reasons for intelligence in handling stoker-fired plants as in hand-fired plants.

Just at this time, although it might sound radical, it would not be far away from good economical judgment to recommend the placing of technically-trained men in every reasonable sized boiler room in this country, charging them with the responsibility of eliminating the waste of fuel. It is not at all advocated that men be replaced, but rather the building up of men to a higher degree of intelligence in the problem of fuel combustion. If all those interested would support a movement of this kind, it would be a speedy solution of one of the big fuel wastes in boiler plants.

There is no question but that engineering progress has been made in the past few years, along certain

defined lines, in the method of utilizing fuel, but when they tell us that hundreds of millions of tons of coal are being wasted every year, this surely is a strong motive for impelling this question of fuel economy.

The government has published a vast amount of information through the Bureau of Mines, Department of the Interior, regarding the utilization of fuels. It has also investigated and made known more efficient methods to be used. If this data were applied to specific cases, there is no question but that a lot of good would be done, and better economy obtained, in the average plant.

Large central stations are going through elaborate processes to determine the most economic way to burn fuel and the best methods for economic operation. On account of the typical power station load, and the desirability of carrying peaks by merely raising the steaming capacity of boilers in service, old equipment is being replaced, in many cases, by more modern equipment.

A few years ago, a large plant in Chicago was using seven and one-half pounds of coal per kw-hour, and, at present, they are using two and seven-tenths pounds of coal per kw-hour, with the same kind of fuel. In 14 years, this engineering progress, in turbine, boiler and stoker equipment and methods of operation, has been equivalent to a saving, in one year, of approximately 2,500,000 tons, or 58,000 carloads, of coal.

In the past few years, a number of engineers have specialized in combustion of fuels and boiler-room operations, but it seems that there has not been very much enthusiasm aroused, on the plant owner's part, in obtaining this expert advice. It is not unusual to find combustion engineers reporting large savings of fuel and labor, which the plant owners accept with interest, but they do not proceed to execute and put in operation any of the recommendations. It is pretty well agreed that it is good practice to obtain engineering advice in the co-relation of equipment, but it has not become very popular to obtain engineering advice on operation of the boiler room.

There has been relatively little organized research work done in connection with combustion of some of the fuels more difficult to burn, and there is ample opportunity for development work and fuel saving in all fields. No general satisfactory method has been successfully developed to handle the fine anthracite

Abstract of paper read before last annual meeting of A. I. S. E. E.

coal and even larger sizes. A few stokers have been developed and a number of installations have been made, but they must be considered special. There is an immense amount of fine anthracite coal on hand without means of satisfactorily burning it. The same remarks can be applied to the burning of coke breeze. This field is even more widely extended. Coke production is increasing, and the coke breeze still demands a satisfactory way of handling it. Vast lignite fields exist in our states which are rapidly becoming populated. This coal is difficult to burn and, although the government has done considerable experimental work towards the utilization of this fuel, it can safely be said that the economic handling of this coal is still in the development stage. There are great fields of semi-anthracite, partially coking coals throughout the United States that have been almost impossible to burn. Research work would open these fields.

Equipment.

There have been few changes in the mechanical design of the overfeed and chain grate types of stoker for burning the high carbon coals found in the East, and high ash coals in the Middle West. Better standards of settings have come into force which have assisted greatly in increasing the economy and overcoming operating and smoke difficulties.

There has been a tendency to install these stokers under conditions which require a quick change in load and where excessive overloads had to be maintained. It has been necessary, therefore, to develop an equipment that would have high economy with these fuels at normal ratings; a wide range of operation, and a large reserve capacity. This has led to the development of the forced draft underfeed stoker.

This development has not been entirely a problem of obtaining high steaming capacities, as is generally supposed. If this were true, natural draft stokers could be installed with excessive grate surface and almost any desired capacity obtained. Even though the character of the boiler setting allowed the installation of more grate surface, if it were required that this equipment be operated at normal rating, the efficiency would be very low, due to the fact that part of the grate surface would not be effective, and there would be no control over the air admission.

From a general survey of power plants, it would seem that the present method of operation is around 150 per cent of boiler rating. At this steaming capacity, the fires are handled very easily, and there is no trouble with clinkers, smoke, brickwork or maintenance. The very best economy is also obtained at this steaming rate. The present-day requirements are to maintain this economy at normal steaming capacities, but to also provide a reserve capacity in the same equipment so that sudden demands for steam can be

met. The need is for flexibility of equipment to meet any kind of emergency. If it is necessary to take a boiler off the line, it is expected that the equipment already in service and under fire will take up the load and handle it with sustained reliability.

Boiler-room economics have demanded that this reserve capacity be placed in the coal-burning equipment and not in idle boilers.

This will probably be more apparent upon studying the conditions of plants that are now replacing natural draft stoking equipment by forced draft underfeed equipment. This equipment is not being replaced because it does not handle the coal properly, or on account of inefficiency, but due to the fact that the rate of combustion is so close to the maximum capacity of equipment that there is no reserve capacity left.

Operating Methods.

Although we often hear that the savings in power plant operation are to be made in the boiler room, it is very seldom that a distinction is made between the possibilities, due to equipment, and that due to the method of operation.

The necessary losses in connection with the generation of steam using coal as a fuel, are from 8 to 10 per cent of the total heat value. The highest theoretical efficiency, therefore, is between 90 and 92 per cent. Combined boiler and grate efficiencies of from 75 to 80 per cent are quite common test results. In other words, from 82 to 89 per cent of all the heat theoretically available is actually utilized, which shows how closely modern steam-generating apparatus approaches the theoretical maximum. When the statement is made, therefore, that the saving in a power station must be made in the boiler room, this remark refers to operation and management and not to the design of the equipment used.

There is not much difference in the equipment used for burning fuel throughout the United States, but there is a wide difference in the operating methods. Many engineers having experience with plants where it is necessary to obtain highly efficient results in producing electrical energy, obtain the wrong operating viewpoint of industrial and moderate size boiler plants, where the boiler plant is merely a side adjunct to the general business.

The waste of fuel is more pronounced in these small plants, and it is not uncommon to find that it is very difficult to enthruse the small plant owner in things that effect economy in the boiler room, either in equipment or operating methods. A large saving in fuel can be made by giving more attention to the methods of operation. This not only includes applying the equipment in order to facilitate easy handling, but also requires that particular attention be given to the character of labor used.

Stripping Ingots With Electric Magnet

Magnet Unloads Scrap Requiring Small Headroom — Charges Furnace in Record Time — Strips Ingots Breaking the Mould Out of the Dried Ganister at the Bottom.

An interesting application of the electric magnet in the steel mill is being made use of by an English firm. At the Stobie Steel Company, Ltd., Dunston-on-Tyne, the electric magnet is used to strip ingots, as shown in the accompanying illustration, which was taken in the steel foundry.

The magnet which is 36 inches in diameter also unloads scrap from the railway trucks on to the dump. This work can only be done efficiently with a magnet, since with manual labor, trucks are held too long, and a grab bucket limits the general use of the crane and requires excessive headroom. With a magnet the dump may be taken up to within one foot or two of the crane level and valuable floor space is saved. It should be remarked that it is advisable to store turnings under cover as far as possible to prevent excessive rusting, and high dumps are obviously an advantage.

For charging purposes the magnet loads the charging trays in a few minutes, the average lift being 700 to 800 pounds of turnings per trip. Owing to the quick energization of the magnet and its instantaneous release of the load, Messrs. Stobie have developed an exceedingly fast method of using it.

It should be remarked that the magnet is fitted with rigid link suspension and has a long "eye." By this means the crane driver, after getting one of the men about the steel works to disconnect the water-tight plug connection used for the electric cable, is able to take his magnet to any convenient place, say at the top of the dump, and disconnect his hook himself, leaving the magnet there while he connects his hook to the charging tray, which is fitted with a similar eye, and proceed to the furnace, where he discharges his load.

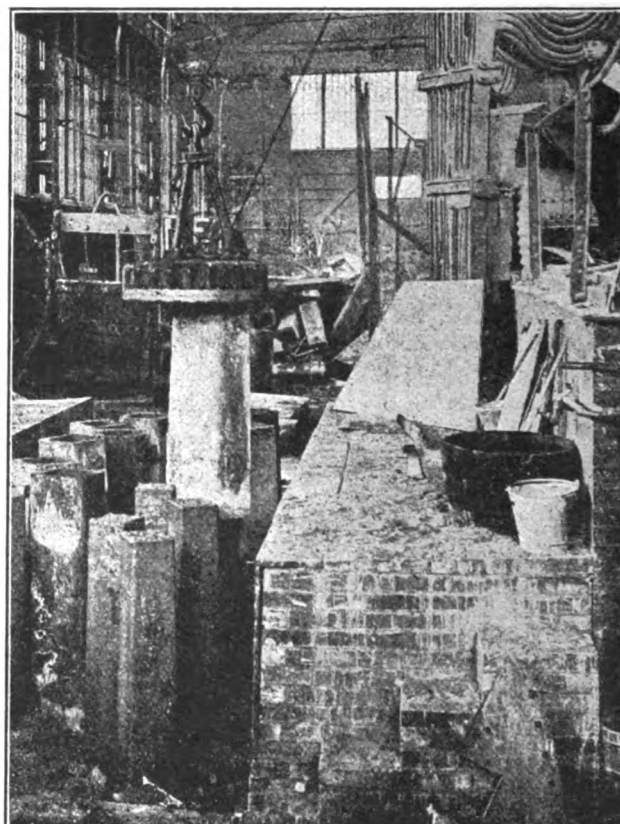
On returning for the magnet he is able to rearrange the hook without any assistance and gets his plug re-connected at any convenient points in the works. This feature, although only a detail, will no doubt appeal to steel works managers.

In further describing this application of the electric magnet, "Engineering" says:

"After the steel has been melted, it is teemed into the ladle and then into ingot moulds. While the ingot is still red hot the crane driver proceeds to use his magnet as a stripper, and the fact that he is able to do so is a tribute to the attractive force of the magnet and to the quality of the ingot. The magnet is called on to break the mould out of the dried ganister at the bottom and to strip it from the ingot. The weight of the mould is about 1,400 pounds. Although very occasion-

ally 'stickers' are met with, we are informed that the bulk of the ingots cast are dealt with by this method.

"As soon as the mould is clear of the ingot it is taken to another part of the works and may be placed



Showing another application of electricity in the steel industry—A magnet is shown stripping ingots.

in any position by the crane driver without assistance. When sufficiently cool the ingots themselves are picked up by the magnet and conveyed about the works as desired.

"The magnet illustrated was designed and built by Messrs. Allen West & Co., Ltd., at their works at Brighton, England, and its performance, as outlined above, we think, speaks for itself. The makers inform us that in addition to being able to work hot metals without injury all their magnets may also be worked submerged, being impregnated and absolutely water-tight."

The use of electricity in the steel industry is becoming more and more important and universal. The above description shows another application which should become very useful for the reasons mentioned in the body of the discussion.

PRODUCTION TOPICS

PIG TIN.

Owing to the very numerous inquiries received from the trade and consumers of pig tin indicating that there is no clearly defined understanding as to the functions of the Sub-Committee on Pig Tin, this committee desires to make its position clear and to this end presents herewith an excerpt from the "Journal" of the War Trade Board, issue No. 3, dated January 8, 1918, on page 8 of which appears a concise statement as to the functions of the various sub-committees including the Sub-Committee on Pig Tin:

"These committees are not given any authority whatsoever in the granting or refusing of import licenses, or in any way on their own initiative to determine who shall or shall not import these commodities, or determine their disposition; but their only functions are to gather such information in the various trades as the government, acting through the War Trade Board, may from time to time direct; to act as consignees of the various commodities as directed; to release these commodities to the importers under instructions from the War Trade Board, and prior to such release to obtain from the importers such guarantees or other agreements as the War Trade Board may require; to keep themselves informed for the benefit of the board as to the use and disposition of the imported commodities and the observance by the importers of any guarantees or agreements given in connection therewith, and to keep full and complete records of all importations of the various commodities."

The Sub-Committee on Pig Tin is using every effort to assist consumers of pig tin under the existing circumstances and will continue to do so; but it desires that the trade and consumers realize the sub-committee's limitations in its field of operation, and that it be relieved of responsibilities which it cannot assume and over which it has no control.

IRON ORE IN 1917.

The iron ore mined in the United States in 1917 amounted to about 75,324,000 gross tons, compared with 75,167,672 tons in 1916, an increase of 0.2 per cent. The figures for the two years are so nearly the same, however, that when the final returns are received from all the producers the actual quantity mined in 1917 may prove to have been less than that mined in 1916. The shipments from the mines in 1917 are estimated at 75,649,000 gross tons, valued at \$236,178,000, compared with 77,870,553 tons, valued at \$181,902,277 in 1916, a decrease in quantity of 2.9 per cent, but an increase in value of 29.8 per cent. The general average value of ore per ton at the mines for the whole United States was, therefore \$3.12 in 1917, as compared with \$2.34 in 1916. The stocks of iron ore at the mines apparently decreased from 10,876,352 gross tons in 1916 to 10,560,000 tons in 1917, or 2.9 per cent.

To obtain these statistics preliminary figures received from producers of nearly 95 per cent of the normal output of iron ore were compiled under the direction of Ernest F. Burchard of the United States Geological Survey, Department of the Interior, and were supplemented by estimates covering the remainder of the output.

About 85 per cent of the ore mined in 1917 came, as usual, from the Lake Superior district, which mined about 63,964,000 gross tons and shipped 64,275,000 tons, these quantities representing a very slight increase and a decrease of 3.2 per cent, respectively, compared with 1916. The shipments of iron ore by water from the Lake Superior district, according to figures compiled by the Lake Superior Iron Ore Association, amount-

ed in 1917 to 62,498,901 gross tons. It thus appears that the iron mining industry in the Lake Superior district has been able to bear the strain of the war demand, but not to duplicate the great record of ore shipments made by lake in 1916, which amounted to 64,734,198 gross tons. The slight falling off, it is understood, was due to less favorable weather for shipping early and late in the season of 1917, rather than to inability of the lake fleet to handle the ore mined.

The South mined and shipped more than 8,100,000 tons of iron ore, the bulk of which was produced in the Birmingham district, Alabama, but the iron mines of Georgia, Tennessee, North Carolina and Virginia contributed about 1,400,000 tons to the total.

The Northeastern states—New Jersey, New York and Pennsylvania—increased their production slightly as compared with 1916, and shipped to blast furnaces approximately 2,446,000 tons of ore. This quantity, however, represented a decrease of 4.1 per cent as compared with the shipments in 1916.

Colorado, New Mexico, and Wyoming, the principal iron-ore producing states in the West, are estimated to have mined and shipped approximately 666,000 tons of iron ore, compared with 717,660 tons in 1916, a decrease of 7.2 per cent.

Other states, such as California, Connecticut, Iowa, Maryland, Massachusetts, Missouri, Nevada, Ohio, Utah, and West Virginia, in which there are small iron mining operations, are estimated to have shipped about 144,000 tons of ore, compared with 134,002 tons in 1916, an increase of 7.5 per cent.

The imports of iron ore for the 11 months ending November 30, 1917, according to the Bureau of Foreign and Domestic Commerce, Department of Commerce, amounted to 913,500 gross tons, so that probably the imports for the whole year reached 988,500 tons, compared with 1,325,736 tons in 1916.

EXTINGUISHING MOTOR AND GENERATOR FIRES.

Some interesting results have been attained by investigations conducted by the General Electric Company, concerning the extinguishing of fires in large, totally enclosed, generators and motors. The results of the experiments indicate that for this type of apparatus, steam, if supplied in sufficient quantities, will put out any fire due to burning insulation. Also, that the insulation after drying will not be materially affected. Steam, while as effective as other means, does not have the objectionable features occurring in the use of carbon dioxide and carbon tetrachloride.

The test apparatus consisted of a sheet iron cabinet, four feet cube; to this was attached a 12-inch pipe, connected with a motor-driven fan, for supplying the necessary draft. Both the inlet and outlet ducts of the cabinet were provided with quick closing dampers. A fire was started with materials such as scrap coils, waste, etc. The fan was operated to deliver a known volume of air. When the combustion had reached a certain stage, the outlet damper was closed and steam admitted to the cabinet. The steam was seen to issue from the inlet to the blower, thus showing that the steam overcame the air pressure from the fan, and filled the cabinet. The experiment was repeated with inlet damper closed. The blaze was extinguished almost instantaneously, but it was found necessary to leave the steam on for 20 or 30 seconds to thoroughly wet the outer surface of coils in order that the charred portions would not ignite again.

A complete report of this test appears in the January issue of the "General Electric Review."

INDUSTRIAL SAFETY

SAFETY IN YARD PRACTICE.

BY F. G. BENNETT, DIRECTOR OF SAFETY, THE BUCKEYE STEEL CASTINGS COMPANY, COLUMBUS, O.*

Attention has been directed to this phase of accident prevention, no doubt by severity rather than frequency of accidents. There has been a general improvement in all plant yards in the iron and steel industry where accident prevention work has been definitely established. This has been brought about by the recognized methods employed in accident prevention, engineering and organization. The engineering phase of this work will be slowly noticeable in established plants, but must be recognized in new construction. There are certain features along structural lines, in our present plants that can be modified, but an extreme hardship will be placed upon certain companies where present construction is so established that changes are almost prohibitive. We have studied and accepted certain safety devices and practices relating to this subject, and these will not be discussed at this time.

In every plant a yard seems to be a necessary adjunct, and, whether large or small, the need of safety attention is apparent. These yards are principally used for the storage and handling of raw material, semi-finished product, finished product, machinery and other articles used in connection with the industry. This necessitates more or less handling or moving. Various means are employed to do this, but railroads are principally used, and this one source of transportation plays an important part in accidents of the severe class.

Intra-Yard Railroads.

In considering intra-yard railroads, we must recognize a different condition than that of main-line railroads, where speed is a factor. This one aspect must have a bearing in formulating clearance rules, either from a statutory viewpoint or otherwise. The state commissions throughout this country, that have jurisdiction over railroads, have thoroughly covered the clearance problem, but this means to be applicable to fast-moving trains.

In plant yards the movement of trains is practically limited to switching, placing of cars on loading tracks and other slow movements. In the steel plants there are movements that require speed, but this can be regulated and provisions made to insure safety. The subject of clearances would not be such a problem if new construction was to be considered, but in established plants, where buildings have stood for a number of years, it is almost prohibitive to make modifications to which clearance rules can be applied. At a recent public hearing before the committee which is endeavoring to formulate rules to govern intra-yard railroads, under the direction of the Industrial Commission of Ohio, the question was raised as to what a safe clearance should be in plant yards, and a majority favored 6 feet 6 inches from center of track. The State of Ohio Public Utilities Commission has adopted a clearance of 7 feet from center of track, as indicated by their rule nine.

There is no doubt in my mind but this is a proper clearance rule. However, we must consider the old installations where this can hardly be applied. There was considerable evidence submitted before the committee to substantiate the 6-foot-6-inch rule. A railroad official stated that a clearance rule for plant yards should embody a 7-foot clearance for running tracks and a 6-foot-6-inch clearance for loading tracks, where material is piled adjacent thereto. This com-

mittee has not completed its work and a final clearance rule has not been adopted.

Warning Signs and Devices.

In plant yards, in connection with railroad tracks, there are always conditions where special safety measures must be employed. I refer to warning signs and other mechanical devices that will warn employes of close clearances. In plants where old installations prevent the application of defined clearance rules, measures of this nature must be employed.

Overhead clearances in plant yards are most commonly applicable to entrances to buildings, and this must be carefully studied and considered when formulating a clearance rule. The roller-type door is of particular importance in the matter of overhead clearances. If too great a clearance is designated, then the danger of the door not being raised its entire height of travel is established, due to the fact that it requires more exertion to operate, and in some cases motive power would have to be used. This would be the case, no matter what clearance rule would be adopted, but the present requirement of Ohio in cases of this kind is a clearance of 21 feet. We must again take into consideration the slow movement of cars when being placed in buildings. A clearance of less than 21 feet can be adopted, and, with the use of warning signs or other devices, this should be ample in relation to safety.

The speed of trains and locomotives in plant yards should receive attention, and in most of our plants this is taken care of through discipline and rules. Conditions govern this phase of railroad transportation to a great extent.

Good Housekeeping.

There is always a phase of this subject that cannot be lightly passed over, and that is general cleanliness and tidiness throughout plant yards. This applies more directly to railroad tracks, and an unceasing campaign to remedy this evil should be inaugurated. A clean-up gang in the large plants, whose duty is limited exclusively to keeping the plant in a clean and orderly condition, will find sufficient work to take up its allotted time. Barriers, constructed of timber of sufficient height to prevent material rolling down, should be erected at the base of all piles where same are located adjacent to tracks. These barriers, of course, should be placed in compliance with clearance rules.

Pedestrians in and about plant yards require protection, and there are many devices employed at the present time. Warning signs and baffles at grade crossings near corners of buildings furnish protection that is acceptable to safety engineers today. Automatic signals are not to be favorably accepted, as the failure of power to produce the signal might bring about disastrous results.

This also applies to doorways from buildings leading out and on to railroad tracks. Buildings which are located close to railroad tracks should have the windows on the ground floor closed by screen or strips to prevent employes using the same as a means of exit. Designated footwalks about plant yards will help to prevent employes from using other avenues and short cuts. The use of railroad tracks as pedestrian avenues should be prohibited.

Use of Searchlights.

A great many of our plants are engaged, either directly or indirectly, in the production of munitions and supplies for the European war, and this has required extraordinary measures being used about our plants in the matter of protection from plotters and others intent upon interfering with this work.

* Paper read before the National Safety Council, September, 1917.

NEWS OF THE PLANTS

FIRE AT DRIVER HARRIS PLANT.

Fire, believed to have been of incendiary origin, swept the plant of the Driver Harris Company, at Harrison, N. J., February 1, entailing a loss of about \$500,000. The company was working on war orders.

The fire started in a building in which no one was employed early in the day. The blaze threatened for a time to spread to nearby factories.

SURVEY OF WESTERN MANGANESE DEPOSITS.

A report has been issued from the Department of the Interior of a United States Geological Survey of some Western manganese ore deposits. Owing to the derangement of oceanic traffic and the foreign manganese industry the United States Geological Survey has put several geologists in the field and details of the deposits examined are being given to the press from time to time. Complete reports will be issued later. The report states that the production of ore containing over 40 per cent manganese increased from 2,635 long tons in 1914 to 122,000 tons in 1917. The production of low grade ore suitable for making spiegel-eisen is increasing in about the same proportion.

The following summary is attached to the report which gives the location of the deposits and their extent and composition:

Estimate of quantity of manganese ore and manganiferous iron ore in certain Western mining districts.

District	Tons probable	Tons possible	No. of deposits in estimate	Approximate composition		
				Mn	Fe	SiO ₂
Philipsburg, Mont.	135,000	350,000	16	37-46	1.5-6	18
Shumla, Tex.....	10,000	100,000	2	15-40	2-5	3-16
Leadville, Col.....	700,000	1,500,000	13	20-25	24-30	10-15
Silver City, New Mexico	500,000	1,000,000	2-	16	35	6
Red Cliff, Col.....	750,000	1,000,000	2	14	38	1-2
Pioche, Nev.	550,000	1,000,000	2	12	34	13

In only a few of the ores from these districts does the phosphorus exceed 0.1 per cent and many analyses show a content as low as 0.002.

PLATE MILL CONTEMPLATED.

The Nova Scotia Steel & Coal Company, New Glasgow, N. S., is negotiating with the government concerning the building of rolling mills for steel plates to be used in ship-building.

REPUBLIC IRON & STEEL BUYS COAL LAND.

The Republic Iron & Steel Company, of Youngstown, O., has recently purchased the property of the Bessemer Coal & Coke Company, in Allegheny county, Pa. The property contains about 3,000 acres of coking coal, which will be able to turn out about 4,000 tons per day.

NEW JAPANESE STEEL PLANT.

Word has been received that the organization of the Oriental Steel Manufacturing Company has almost been completed. The company plans to build two blast furnaces having a capacity of 250 tons per day, the rolling mill capacity to be about 100,000 tons of ingots per year.

SLAG TARIFF DECISION.

United States Judge W. H. S. Thompson on January 31 handed down an opinion in a case of the Baltimore & Ohio Railroad Company against the Carnegie Steel Company, the decision being in favor of the railroad company regarding the collection of "slag and refuse" tariffs. The decree closes all litigation, in the district court at least, between seven large Eastern railroads and practically every one of the large steel and iron producing concerns in the Pittsburgh district. Twenty-eight cases that are pending will be governed by a supplement to the opinion, which places all the suits in the same class.

Judge Thomson's decree opens a way for the collection of several hundreds of thousands of dollars by the railroads from the steel companies for tariffs for the transportation of "waste" from their mills to dumping grounds.

ADEQUATE MAGNESITE SUPPLY.

Recent developments in the magnesite mining industry in California and the discovery of huge deposits of magnesite in Stevens county, Washington, assure us that the domestic production will quickly supply not only our own needs but also a surplus for the Allies, according to the United States Geological Survey Press Bulletin. Until 1915 the United States produced only 10,000 tons of its annual consumption of 300,000 tons at that time. The estimated production of these two districts for 1917 was 315,000 tons and 1918 promises an increase. The increasing use of magnesite cement for composition flooring in addition to refractory brick has helped greatly to increase the demand and stimulate production.

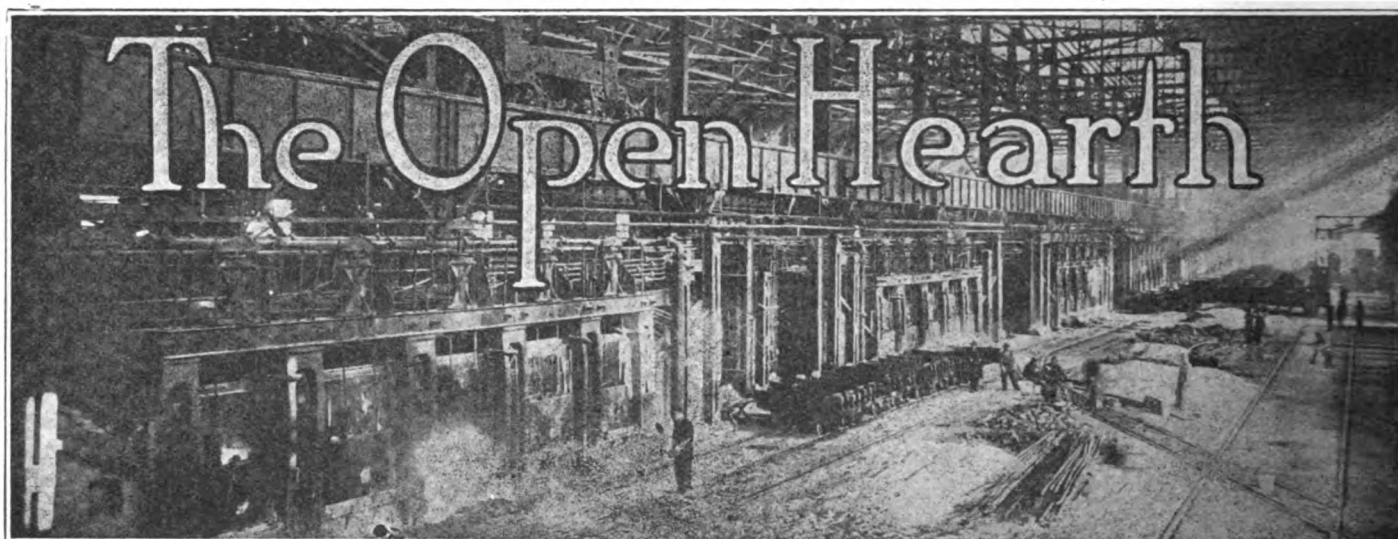
UNITED STATES DEPARTMENT OF LABOR BULLETIN No. 218.

The Bureau of Labor Statistics of the United States Department of Labor has just published a report of the wages and hours of labor in the steel industry. The statistics covered in the report end in May, 1915, and the report contains a complete survey and analysis of the period of depression that had existed in the two or three preceding years. The report includes figures on the wages of labor in blast furnaces, open hearth plants, Bessemer steel plants, sheet and tin plate mills, plate mills, blooming mills, rail mills, bar mills and puddling mills.

A valuable addition to this report is a glossary of iron and steel occupational terms, covering not only the principal occupations, but many of the minor ones as well.

URGENT NEED FOR MEN IN THE ORDNANCE DEPARTMENT.

The United States Civil Service Commission is conducting an extensive campaign for the thousands of workers needed for the prosecution of the war in connection with the Ordnance Department of the Army. A vast number of positions are available, commanding salaries within the ranges indicated below: Clerical positions at \$1,100-\$1,800; testing engineers, \$1,000-\$2,400; mechanical trades positions, \$2.75 per day up; drafting positions, \$800-\$3,000; inspection positions, \$1,000-\$2,400. Further information will be furnished by the representative of the United States Civil Service Commission at the postoffice or custom house in any city, or by the Civil Service Commission in Washington, D. C.



A. S. Hellstrom, formerly with the Union Spring & Manufacturing Company, has accepted a position as melter on electric furnaces at the General Steel Company, St. Francis, Wis.

✓ ✓

E. H. Williams, superintendent of the McKeefrey Iron Company, Leetonia, O., has been commissioned a major in the United States Engineers' Reserve Corps, and has been ordered to active duty at Camp Lee, Petersburg, Va.

✓ ✓

A. R. Vanderford has been appointed superintendent of the foundry operated by the Youngstown Sheet & Tube Company. Mr. Vanderford was formerly identified with the Cumberland Foundry & Machine Company, of Nashville, Tenn.

✓ ✓

E. J. Janitzky succeeds L. G. Pritz as metallurgical engineer of the Illinois Steel Company, South works, South Chicago, Ill. Mr. Pritz is now connected with the Timken Roller Bearing Company, Canton, O.

✓ ✓

Frank Samuel, of the firm of Frank Samuel, Philadelphia, Pa., has been made a member of the sub-committee of ferro-alloys of the American Iron and Steel Institute.

✓ ✓

At the annual meeting of the Engineers' Society of Western Pennsylvania, recently held in Pittsburgh, W. E. Snyder, mechanical engineer, American Steel & Wire Company, was elected president; W. C. Hawley, Pittsburgh Water Company, vice president; and A. Stucki, contracting engineer, Oliver Building, Pittsburgh, treasurer. Robert Linton and A. N. Diehl, the latter assistant to the vice president of the Carnegie Steel Company, at Pittsburgh, were elected directors for the three-year term. K. F. Treschow is secretary, having succeeded Elmer K. Hiles, who is now in service in France with the engineers' reserve corps.

✓ ✓

J. M. Sampson, formerly chief melter at the Watertown Arsenal, has been made assistant superintendent of the Watertown Arsenal foundry in charge of all melting, including open hearth, electric and converter operation.

✓ ✓

Frederick W. Wood has retired as general manager of the Sparrows Point, Md., plant of the Bethlehem Steel Company. He was at one time in the open hearth department of the Pennsylvania Steel Company, and later was superintendent of blast furnaces and general superintendent. W. Frank Roberts has been made general manager.

E. Cooper Wills has been appointed superintendent of the Rahway, N. J., plant of the Nagle Steel Company, Pottstown, Pa.

✓ ✓

W. P. Chinn has been appointed assistant general manager of all iron mines of the Pickands, Mather & Co., Cleveland, O. He was formerly general superintendent of the Mesaba range.

✓ ✓

J. Fankhouser, formerly at the Gary plant of the American Sheet & Tin Plate Company has been made assistant general manager of that company's plant at New Castle, Pa.

✓ ✓

C. D. Dyer, Jr., is now connected with the American & International Shipbuilding Company, Philadelphia, Pa. He was formerly efficiency engineer with the By-Product Coke Corporation, South Chicago, Ill.

✓ ✓

R. T. Gladstone, formerly master mechanic of the Washington Steel & Ordnance Company, has accepted a position as general superintendent of the Steel Products Company, Huntington, W. Va.

✓ ✓

E. E. Kiefer, formerly with the Cambria Steel Company, at Johnstown, Pa., is now chief draftsman at the Worth Brothers Company's plant of the Midvale Steel & Ordnance Company.

✓ ✓

W. P. Allen is now connected with the Tennessee Coal, Iron & Railroad Company. He was formerly chief engineer of the Anniston Ordnance Company and the Anniston Steel Company, Anniston, Ala.

✓ ✓

Robert J. Anderson resigned from his position as chief chemist and metallurgist of the Cleveland Metal Products Company on February 1.

✓ ✓

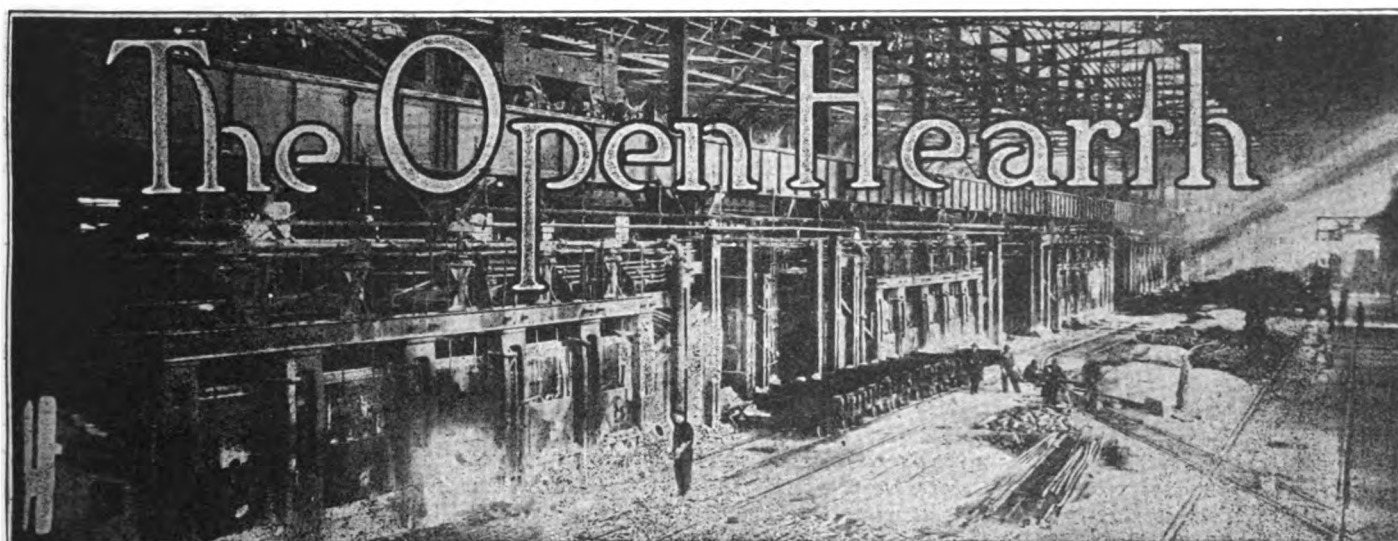
Arthur Baer, formerly assistant superintendent of blast furnaces at the South works of the Illinois Steel Company, has been made superintendent of the new blast furnaces of the Mark Manufacturing Company, at Indiana Harbor.

✓ ✓

Thomas Saddler is now at the Shenango works of the American Sheet & Tin Plate Company. He was formerly assistant general manager of the same company's plant at New Castle, Pa.

✓ ✓

F. H. Bird, engineer for the American Steel Foundries, Chicago, Ill., has received a commission of first lieutenant in the Ordnance Department of the United States Army.



The following are elected to membership of the American Iron and Steel Institute, January, 1918, meeting, subject to occurrence of vacancy: Herman M. Knapp, American Bridge Company, Cincinnati, O.; J. Heber Parker, The Carpenter Steel Company, Reading, Pa.; Wilbur W. Gregg, The Harrow Spring Company, Kalamazoo, Mich.; Alfred H. Chapin, Moore Forging Company, Springfield, Mass.; Edgar J. Reilly, William B. Pollock Company, Youngstown, O.; James P. Walker, Illinois Steel Company, Chicago, Ill.; O. C. Davidson, Oliver Iron Mining Company, Iron Mountain, Mich.; E. Theodore Sproull, The Trumbull Steel Company, Warren, O.; George W. Balkwill, Cleveland Steel Casting Company, Cleveland, O.; Joseph K. Pollock, Rogers, Brown & Co., Cincinnati, O.; James B. Kennedy, Brier Hill Steel Company, Youngstown, O.; Donald C. Bakewell, Duquesne Steel Foundry Company, Pittsburgh, Pa.; Robert A. Bull, Duquesne Steel Foundry Company, Pittsburgh, Pa.; Edward F. Clark, Liberty Steel Company, Warren, O.; Ewen C. Pierce, Brown Hoisting & Conveying Machine Company, Cleveland, O.; John H. Bradley, Pratt & Letchworth, Buffalo, N. Y.; C. A. Fisher, Jones & Laughlin Steel Company, Pittsburgh, Pa.; William H. Fitch, Fuller Engineering Company, Pittsburgh, Pa.; William McBride, Fort Pitt Spring & Manufacturing Company, Pittsburgh, Pa.; A. B. Marble, Jones & Laughlin Steel Company, Boston, Mass.; George P. Warner, Pratt & Letchworth Company, Buffalo, N. Y.; H. F. Holloway, Jones & Laughlin Steel Company, New York City, N. Y.; Charles H. Sloan, Andrews Steel Company, Newport, Ky.; Hamilton B. Bole, The Hydraulic Pressed Steel Company, Cleveland, O.; W. H. Geesman, The Brier Hill Steel Company, Youngstown, O.; Milford Wortham, Seaboard Steel & Manganese Corporation, Temple, Pa.; George M. Clark, Ohio Falls Iron Company, New Albany, Ind.; William F. Robertson, Tower Manufacturing Company, Cincinnati, O.; Morris L. Stephenson, Wellston Iron Furnace Company, Jackson, O.; William J. Bradley, Rail Joint Company, Troy, N. Y.; George L. Claypool, Banning, Cooper & Co., Pittsburgh, Pa.; William W. Hearne, The Matthew Addy Company, Philadelphia, Pa.; Ira O. Jones, Wisconsin Steel Company, Chicago, Ill.; John Turner Moore, Reading Steel Casting Company, Reading, Pa.; McCormick G. Moore, Reading Steel Casting Company, Reading, Pa.; Albert N. Abbe, American Hardware Corporation, New Britain, Conn.; Samuel O. Hobart, Eastern Steel Company, Pottstown, Pa.; John B. Smiley, Smiley Steel Company, New York City, N. Y.; John C. Vance, John C. Vance Iron & Steel Company, Chattanooga, Tenn.; Samuel E. Stephenson, Wellston Iron Furnace Company, Jackson, O.; John F. Havemeyer, Concrete Steel Company, New York City, N. Y.; George C. Moon, manufacturer of wire rope,

Garwood, N. J.; Lawrence Hamill, The Hamill-Hickox Company, Cleveland, O.; Robert D. Samuels, Nat. Enameling & Stamping Company, New York City, N. Y.; William J. Fleming, The Bourne Fuller Company, Cleveland, O.; Roscoe C. Skiles, Ohio Seamless Tube Company, Shelby, O.; John B. Guernsey, Old Dominion Pig Iron Corporation, Roanoke, Va.; Charles J. McIntosh, Federal Bridge & Structural Company, Waukesha, Wis.; George E. Hitchins, National Tube Company, McKeesport, Pa.; Edwin T. Wood, LaBelle Iron Works, Steubenville, O.; Charles E. Beeson, Pittsburgh Steel Company, Pittsburgh, Pa.; David P. Bennett, Pittsburgh Steel Company, Pittsburgh, Pa.; John Bindley, Pittsburgh Steel Company, Pittsburgh, Pa.; Charles G. Davis, Davis Brothers, Philadelphia, Pa.; Samuel D. Latty, The Kirk-Latty Manufacturing Company, Cleveland, O.; Charles D. Robb, C. W. Leavitt Company, New York City, N. Y.; Carleton S. Koch, Fort Pitt Steel Casting Company, McKeesport, Pa.; John K. Furst, Pennsylvania Engineering Works, New Castle, Pa.; Frederick W. White, Mutual Chemical Company of America, New York City, N. Y.; Harry L. McGee, Concrete Steel Company, New York City, N. Y.; William O. Batchelder, General Electric Company, Chicago, Ill.; W. C. Franz, Algoma Steel Corporation, Ltd., Sault Ste. Marie, Can.; Charles C. Steel, Sweet's Steel Company, Williamsport, Pa.; Douglas S. Thropp, Everett, Pa.; Charles H. Newcomb, Crocker Brothers, Philadelphia, Pa.; Harris K. Masters, W. R. Grace & Co., New York City, N. Y.; Alfred Stansfield, McGill University, Montreal, Can.; Frank B. Clarke, Lucey Manufacturing Corporation, Pittsburgh, Pa.; Albion H. Wardwell, National Tube Company, McKeesport, Pa.; Louis H. Winkler, Cambria Steel Company, Johnstown, Pa.; Adolph E. Brion, Peter A. Frasse & Co., Inc., New York City, N. Y.; Charles B. Ellis, American Vanadium Company, New York City, N. Y.; Augustus D. Ledoux, importer of pyrites, New York City, N. Y.

V V

J. H. Bickley, who has been connected with the Reading Iron Company for a number of years, has recently accepted a position as superintendent of inside engineering with the Merchant Shipbuilding Corporation, at Bristol, Pa.

V V

Charles A. Swan is now with the Hess Steel Corporation, Baltimore, Md. He was formerly superintendent of the Becker Steel Company of America.

V V

C. E. Goodfellow, formerly assistant to the superintendent of the Donner Steel Company, at Buffalo, N. Y., is now in the government's service.

Some Pointers on By-Product Coke Oven Operations

COKING OF ILLINOIS COALS.

In a recent Bureau of Mines bulletin entitled, "Coking of Illinois Coals," the following interesting data is given regarding the possibilities of its use:

"In general, Illinois coke is light. The cells are not large, but are numerous enough to give a fairly high percentage of porosity. As the cell structure is irregular and the cell walls are thin, the coke is friable. When it is handled, Illinois coke tends to shatter and form a large amount of breeze. Usually the coke comes from the oven in pieces of medium size which have a tendency to break into long finger-like fragments and to become cross-fractured. A characteristic feature is the presence of considerable non-fused material. The percentages of ash and sulphur are usually high. Available tests indicate that for a given purpose more coke from Illinois coal will be required than if coke from Eastern coal is used. The quality of coke made from Illinois coal is improved by mixing low-volatile coking coal with it.

The value of the coke from some of the coals was tested for certain purposes, but the coke from the majority of samples was judged by appearance and physical properties. As the relation between the results of physical tests of coke and its value in practical use is indefinite, different observers may differ widely in their opinions as to the suitability of a given coke for any purpose. Usually the tests made were conducted under operating conditions that gave satisfactory results with other coke, and without regard to any difference in the nature of the Illinois coke. The quantity of coke available was usually too small to permit tests to determine how far changes in practice would effect economy. If through the knowledge gained by experience methods of use could be changed to suit the coke, better results would probably be obtained.

As is described in detail in a subsequent section, fairly good coke was produced in beehive ovens from some of the coals, whereas the coke from others was poor, and a few samples did not coke at all. The best cokes were light gray and silvery, with a good cell structure. The pieces were of fairly large size, but were friable.

A few tests were made to determine the fitness of the coke for metallurgical use. Among these were the cupola tests by the United States Geological Survey, which demonstrated that the coke could be used in the foundry, but was not good as coke from Eastern coal. A trial-run of about 24 hours was made in a blast furnace at the plant of a large iron and steel company. After four hours the furnace began to slip and became rather cold, and worked in this manner until all of the Illinois coke had been used.

Most of the tests of Illinois coal alone in by-product ovens were made with the coals that had given the most promising results in beehive ovens. Therefore the quality of the coke from different by-product oven tests did not vary so much as did the coke from beehive oven tests. The coke was not as strong as by-product coke from Eastern coals. The structure was fairly uniform, the cells were small and numerous, and the cell walls were thin. The coke had a tendency to break into pieces about 6 inches long and 1 or 2 inches in diameter. Some of it showed numerous cross-fractures. When tumbled in a pile it gave a rustling sound and did not have a metallic ring. It contained considerable non-fused material.

Coke made in by-product ovens from mixture of Illinois coals with low-volatile coking coals was of better quality

than that made from Illinois coals alone. The pieces were blocky, the coke was less friable, and the tendency to cross-fracturing was somewhat reduced. Mixtures containing 20 per cent of Illinois coal gave better results than mixtures containing larger percentages.

Opinions as to the value of Illinois coke for metallurgical work differ. Most observers agree that it is not suited for use in large blast furnaces, but some think that it can be used in small furnaces, foundries and smelters. Because of the cell walls being thin, it will not withstand the action of carbon dioxide nor bear the furnace burden as well as coke from Eastern coal. It has been used to some extent during periods when furnaces were slack, but without regard to efficiency, being consumed chiefly to maintain the supply of blast furnace gas for power. A trial made in a copper furnace demonstrated that the coke would carry the burden in a furnace of that type.

If absolutely necessary this coke could be used for some metallurgical purposes. It might be used at the present time if it could be sold at a considerably lower price than metallurgical coke from Eastern coal. Just what the difference in price must be can be determined only by a furnace test covering a considerable period of time. However, there are difficulties in the way of any considerable price reduction. The cost of mining coal is about the same as that of mining Eastern coal that makes highly satisfactory coke, but most Illinois coal requires washing, which adds to the cost.

The mixtures tested in by-product ovens ranged from 20 to 90 per cent Illinois coal with different varieties of low-volatile coking coal. In gas retorts results were obtained with the use of one-third Illinois coals in combination with several Eastern gas coals. The use of 20 to 30 per cent of Illinois coal, mixed with a low-volatile coal for making metallurgical coke, offers promise of success. Interest in this subject is active at present and the question of whether the use of such coke is profitable may be definitely answered in the near future.

The cell walls are stronger and there is less tendency to lingering and cross-fracturing than in coke made from Illinois coals only. Compared to coke made from mixtures of Eastern coals it may have an advantage in one respect of Eastern coals—the cell walls being somewhat thinner a relatively larger percentage of surface is exposed to the action of oxygen, so that the coke burns more rapidly, the heat is generated in a small area, and the furnace drives faster. This property is desirable if combined with cell-wall strength sufficient to withstand the burden in the furnace. However, in general, the addition of Illinois coal to Eastern coal should be considered an adulteration, and the question is, How much can be added without reducing the quality of the coke to the point where it cannot be used for metallurgical work?

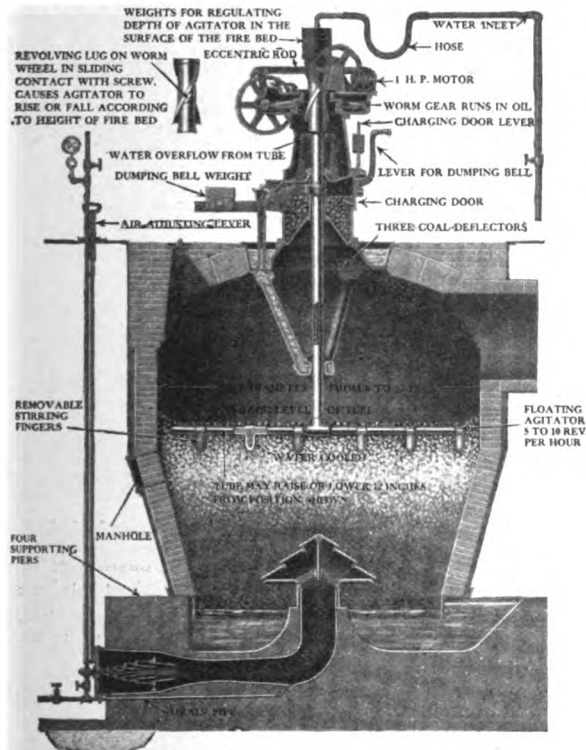
Coke from mixtures of 20 per cent Illinois coal and 80 per cent low-volatile coal has been used in blast furnaces for several consecutive weeks. No great trouble was experienced, although there were some soft spots in the coke. As far as furnace operation is concerned, coke from such a mixture can be used. Possibly the proportion of Illinois coals can be increased to 30 per cent or more, but the use of even 20 per cent in all the by-product ovens near the Illinois coal field would mean a large annual consumption. There are more than 1,500 by-product ovens, with a capacity of about 9,000,000 tons of coal annually, within a short distance of this field."

WITH THE EQUIPMENT MANUFACTURERS

FLOATING AGITATOR FOR GAS PRODUCERS.

Something entirely new in the gas producer line is now being offered the trade by the Chapman Engineering Company, of Mt. Vernon, O.

The cut illustrates the simple construction of this machine. The agitator is in the form of an inverted tee, made of double-



Cross-section of producer, showing agitator.

extra-heavy seamless tubing. It revolves through the surface of the firebed at the rate of five revolutions per hour, or more if desired. The cross-arms of the tee are provided with stirring fingers made of high carbon steel. An inner tube carries cooling water to the end of each finger.

The important feature of this agitator is that it automatically accommodates itself to the varying height of the firebed. This raising and lowering is accommodated by a special driving-head provided with two large screw-like spiral flanges. These flanges engage in sliding contact with two lugs, projecting inwardly from the hub of the driving wheel. Normally the driving wheel and driving-head revolve together, but should the agitator strike an obstruction, or become submerged too deeply in the firebed, it automatically "screws up" at once to a point where the forces are again in balance.

If an excessively high firebed ever caused the agitator to "float" up to its extreme limit (2 feet), it would automatically release, thus relieving all strain upon the machinery. The mechanism is driven by a 1 hp inclosed-type motor.

The agitator is not designed to break up clinkers after they are formed, but to prevent their formation by destroying the blowholes and hot spots, which are the primary cause both of clinkers and of poor gas. It is claimed that the frequent stirring of the entire surface of the firebed greatly increases the capacity, and improves the quality and

uniformity of the gas. Practically all hand-poking is said to be eliminated.

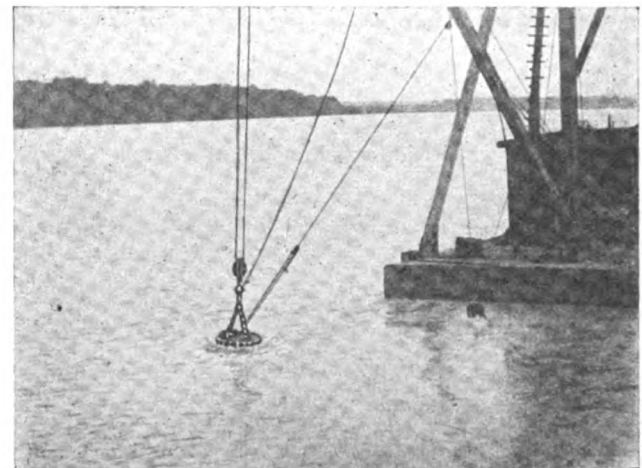
This machine is remarkable for its flexibility and simplicity. It can easily be applied to any type of stationary producer already in use. Its makers guarantee that it will "increase the capacity 75 per cent, reduce the hand-poking 75 per cent, and maintain a richer and more uniform quality of gas."

These agitators are made by the Chapman Engineering Company in two different forms. First, as a part of a complete producer. Second, separately from the producer proper, to be installed on old style hand-poked producers already in use. The agitator is built with or without an automatic coal feeder, as required by local plant conditions.

RECOVERING LOST PIG IRON.

The Arrow Transportation Company, operating a line of barges on several of the Southern rivers, lost one of its barges in the Tennessee river, near Paducah, some time ago. This barge, loaded with about 420 tons of sand-cast pig iron, collided with the pier in the river and the barge began listing, dropping its load gradually and, therefore, strewing the pig iron along the bed of the river for a distance of about 100 feet or more. The loss represented about \$10,000, and the insurance company paid over this amount to the transportation company. The insurance company later made arrangements to recover what they could of the cargo by means of a barge and a lifting magnet, purchased from the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis. By letting the magnet down to the bed and dragging it along the vicinity in which the material had sunk, over 90 per cent, or approximately 400 of the 420 tons, were recovered.

The cargo was not only saved, but because of the rising cost of pig iron it was sold for \$16,000, while the total cost



Lifting magnet just reaching the surface of the water on its way up.

of recovering, including the rental of barges and the purchase of a magnet, amounted only to \$4,000, which gave the insurance company approximately \$2,000, plus a lifting magnet, which has since been put to use in salvaging other lost cargoes. The magnet used was 43 inches in diameter, and of the standard C-H type, which is waterproof.

WITH THE EQUIPMENT MANUFACTURERS

ELECTRIC MONO-RAIL HOISTS FOR HANDLING ASHES.

A mono-rail electric hoist, with a bottom dumping bucket is being used for handling ashes and is the type of machinery which lends itself readily to such installations. Installations of this nature are particularly serviceable where the ashes are pulled out on the boiler room floor. The Philadelphia Paper Company, of Manayunk, Pa., has obtained excellent results with a Link-Belt mono-rail hoist of this type.

This machine runs on the lower flange of an I-beam track. It is operated by a man traveling in a trailer cage, who controls the raising or lowering of the bucket, as well as the travel of the hoist. Fig. 1 shows the machine in the boiler house, through which the track runs, and continues on out over a railroad siding, as shown in Fig. 3.

The laborers who clean the fires, fill the bucket with ashes; the operator then hoists his bucket, and runs it out directly over the car, where he dumps it in the cage by the motion of a lever. The current required is very small. Compare this method with that of wheeling ashes, and note the saving in time and labor.

About 30 tons of ashes are handled daily. They are pulled out every six hours. Two men do the work of shoveling into the bucket, and then often one of them gets into the cage and runs it out over the car; at other times, to hurry the work, an additional man operates the hoist, remaining in the cage. The bucket holds $1\frac{1}{4}$ cubic yards, and is handled by a two-ton hoist.

This machine is very compact and requires little head-room—a most important consideration in an installation of this kind, where it is necessary to get a large bucket over the side of a high-side gondola car. All the gears operate in oil, and are entirely enclosed in housings. Any other type of machine would not be suitable for handling ashes.

In this plant a most satisfactory steel suspension bunker supplies coal to the stokers. In many instances, however, an overhead bin cannot be installed for lack of space. It may then be practicable to use the same mono-rail hoist system to handle the coal as well as the ashes. Fig. 2 shows a tipping bucket about to discharge coal into a stoker hopper. Better even than this, is a bucket with a small chute and under-cut gate.

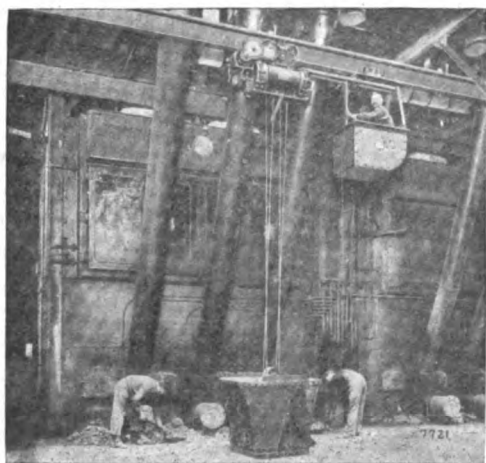


Fig. 1—Mono-rail hoist with bucket in boiler room.

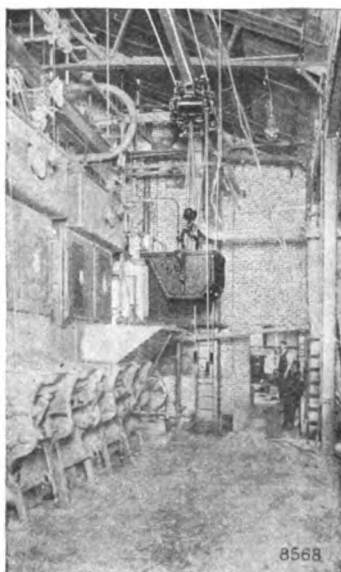
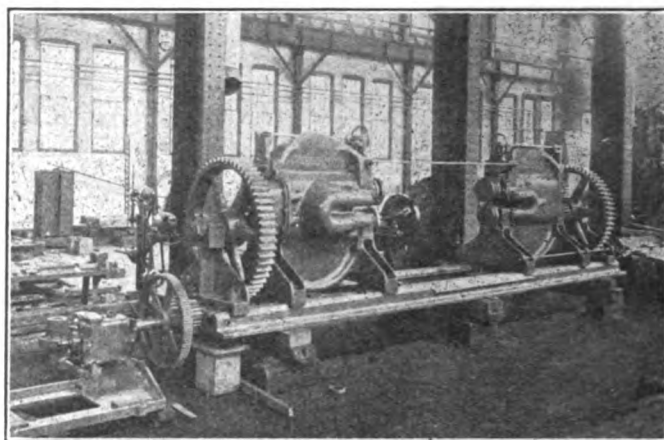


Fig. 2—Use of mono-rail hoist with tipping bucket to discharge coal into stoker hopper.

ROTARY PLATE SHEAR.

The R. S. Newbold & Son Company, of Norristown, Pa., have perfected a rotary shear, several interesting installations of which have recently been made. Rotary shears were, of course, used many years ago but they were thrown out because of the inability to secure a straight cut. By the application of the guide and sliding grip for holding the tail of a plate in conjunction with the double rotary shear, the prob-



Rotary shear with guide and sliding grip for holding plate.

lem has been solved, and it is now possible to trim a plate of any width, length and thickness up to $1\frac{1}{2}$ inches, absolutely parallel and give a merchantable sheared plate on this machine.

Under the existing conditions and high cost of labor it has been necessary for the mill owners to find some way to cut down the cost of production of plates and, after investigation, a great many of them have decided that the machine above referred to is one which will materially reduce labor cost and at the same time increase the production of the mills and the quality of the product.

The machine has lately been developed to a point where its efficiency is unquestionable, and within the past two or three months a machine to cut up to and including $1\frac{1}{2}$ -inch thick steel plate, 120 wide by any length, has been built for Davy Brothers, Ltd., England.

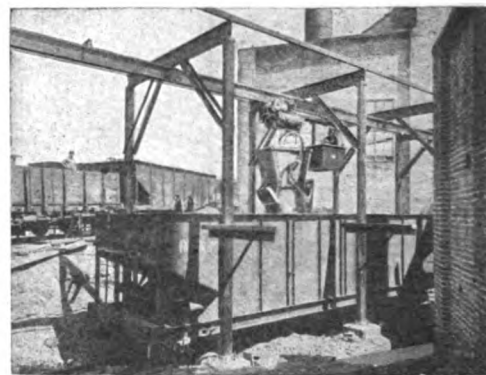


Fig. 3—Ashes being dumped into railroad car.

Trade Publications

"My Dear Jim" is a very interesting pamphlet recently issued by the Carnegie Steel Company. The pamphlet is written in the form of "A Letter from a Retired Steel Man to a Friend in Medicine Hat," in which the writer in a few pages reviews the growth of the Carnegie Steel Company and gives his friend a complete description of the company's works at present and of the entire list of products.

National Tube Pipe—The National Tube Company has gotten out a brief pamphlet entitled, "Rubber? No!" which illustrates the remarkable ductility of "National" pipe.

Hydro Gas Meters—Catalog E of the Bacharach Industrial Instrument Company is descriptive of the above mentioned type of meters and the theory connected with them. The catalog also goes into the construction, use and application of this type of recording meters.

Electric Heaters—The Cutler-Hammer Manufacturing Company has published for distribution two small folders, dealing with electric heating. One is called the "C-H Electric Space Heater Unit," which is particularly suitable for industrial application. C-H electric air heaters are made in a number of sizes and are finished suitable for home and office.

Power Transmitting Machinery—Junior catalog No. 38 of the Bond Foundry & Machine Company, of Manheim, Pa., gives complete details of this company's line of bearings, couplings, pulleys, hangers, brackets, etc. The "Bond" patent "Spiro" compression coupling requires no key and is made in sizes up to 4 15/16 inch shaft.

Zelnicker's Bulletin No. 230—This bulletin is now off the press for distribution. The bulletin contains description of a great amount of second-hand equipment of various kinds, particularly railroad and traction equipment and storage tanks.

Recuperative Gas Oven Furnaces—Bulletin No. 160 of Tate-Jones & Co., furnace engineers, gives a good and interesting description of the construction and scientific principles of their line of improved gas oven furnaces for accurate temperature work in hardening carbon steel, preheating or reheating high speed steels, enameling, hardening, etc.

Bank and Public Holidays Throughout the World—The first compilation of this sort of information is being distributed by the Guaranty Trust Company, of New York.

The Ideal Drive for Rubber Mill Machinery—The latest book issued by the Link-Belt Company deals with this phase of power transmission, and illustrates a number of extensive installations of silent chains in this kind of work.

Waste in Boiler Rooms—A manual published by the Harrison Safety Boiler Works of Philadelphia, Pa. The book is

a reference to aid in securing and maintaining plant economy. The book gives an exhaustive treatment on such subjects as fuels, combustion, heat transfer, boiler testing, plant proportioning, meters and heaters.

Link-Belt Billet Slings for Forge Shops is a folder illustrating the use of billet chains in connection with forging heavy guns.

Disconnecting Hangers—The Thompson Electric Company, of Cleveland, O., in its catalog B-16 presents its line of disconnecting lap hangers in a number of sizes and styles.

Foundry Pan Catalog—The American Clay Machinery Company, of Bucyrus, O., has a new catalog out which is complete and interesting on the subject of the foundry pan. This is probably the first catalog ever issued on this subject.

Department of the Interior, Bureau of Mines, has issued the following publications: Bulletins—Bulletin 130, "Blast Furnace breakouts, Explosions, and Slips, and Methods of Prevention," by F. H. Willcox. 1917. 280 pp., 2 pls., 37 figs. Bulletin 152, "Abstracts of Current Decisions on Mines and Mining, January to April," by J. W. Thompson. 1917. 79 pp. Bulletin 153, "The Mining Industry in Alaska in the Calendar Year 1916," by S. S. Smith. 1917. 91 pp. Bulletin 158, "Cost Accounting for Oil Producers," by C. G. Smith. 1917. 123 pp.

Trade Notes

The Mesta Machine Company, of Pittsburgh, Pa., has opened a branch office at 312 Munsey Building, Washington, D. C.

Guy E. Tripp, of New York, heretofore chairman of the Westinghouse Electric & Manufacturing Company, has been appointed by the War Department as chief of the Production Division of the Ordnance Department, intrusted with the task of supervising and stimulating the production of all ordnance supplies.

The Shepard Electric Crane & Hoist Company has moved its Pittsburgh office to 910 Union Arcade Building.

George S. Thompson, Paris representative of the Vulcan Steel Products Company, of New York, has recently been appointed to the Purchasing Board of the American Expeditionary Forces in France.

D. H. Botchford has been promoted to the position of general manager of the Columbia Steel Company, San Francisco, with his main office at Pittsburgh, Cal. A. M. Clark continues as manager of the company's plant at Portland, Ore.

A. P. Watt has opened offices in New York City as metallurgist, where he will specialize on the concentration of ores and the treatment of industrial wastes. His offices are at 52 Vanderbilt avenue, room 1903.

C. H. Vom Baur, well known in the electric steel industry, and formerly with

Hamilton & Hansell and other concerns, has opened an office at 30 Church street, New York, where he will engage in consulting work and introduce a furnace of his own design.

D. Gleisen is now manager of the industrial bearings division of the Hyatt Roller Bearing Company, Newark, N. J. Mr. Gleisen is a mechanical engineer, Stevens Institute, and has been connected with the Hyatt Roller Bearing Company for the past six years. He was formerly assistant manager of the Hyatt company in charge of the industrial bushings sales.

The extensive new buildings of the Hydraulic Press Manufacturing Company, at Mt. Gilead, O., are now occupied and the plant is again in operation to its full capacity. The new equipment represents the most advanced types of metal-working machinery available, and is specially adapted for the building of hydraulic presses, pumps and valves.

Obituary

Christopher W. Levalley, founder and chairman of the board of directors of the Chain Belt Company, of Milwaukee, Wis., died suddenly of heart failure at his home on Friday, January 4. Mr. Levalley was a Civil War veteran and a pioneer in the development of chain drives. He was also connected with the C. O. Bartlett & Snow Co., of Cleveland, O., and the Federal Malleable Company, of Milwaukee, Wis.

The Driver-Harris Company, of Harrison, N. J., announces the death on January 21 of F. A. Driver, at the age of 82 years. Mr. Driver was a director of the company for many years and identified with it since its inception.

Society Meetings

A. I. S. E. E. Pittsburgh section meeting February 16, 1918, at Hotel Chatham. Paper to be read by Mr. Lindquist, of the Otis Elevator Company, on "AC and DC Skip Hoists."

A. I. S. E. E. Philadelphia section meeting, March 1, 1918. Paper to be read by John S. Rowan, of the Rowan Controller Company, on "Standardized Mill Table Controllers."

Engineers Society of Western Pennsylvania annual meeting of mechanical section, February 5, 1918. Paper to be read by Frank Thornton, Jr., on "Electricity as a Substitute for Natural Gas for Heating Purposes."

American Institute of Mining Engineers, 29 West Thirty-ninth street, February 18-21, 1918.

National Safety Council, annual congress for 1918 will be held at St. Louis, Mo., the third week in October. Headquarters will be at the new Statler Hotel.

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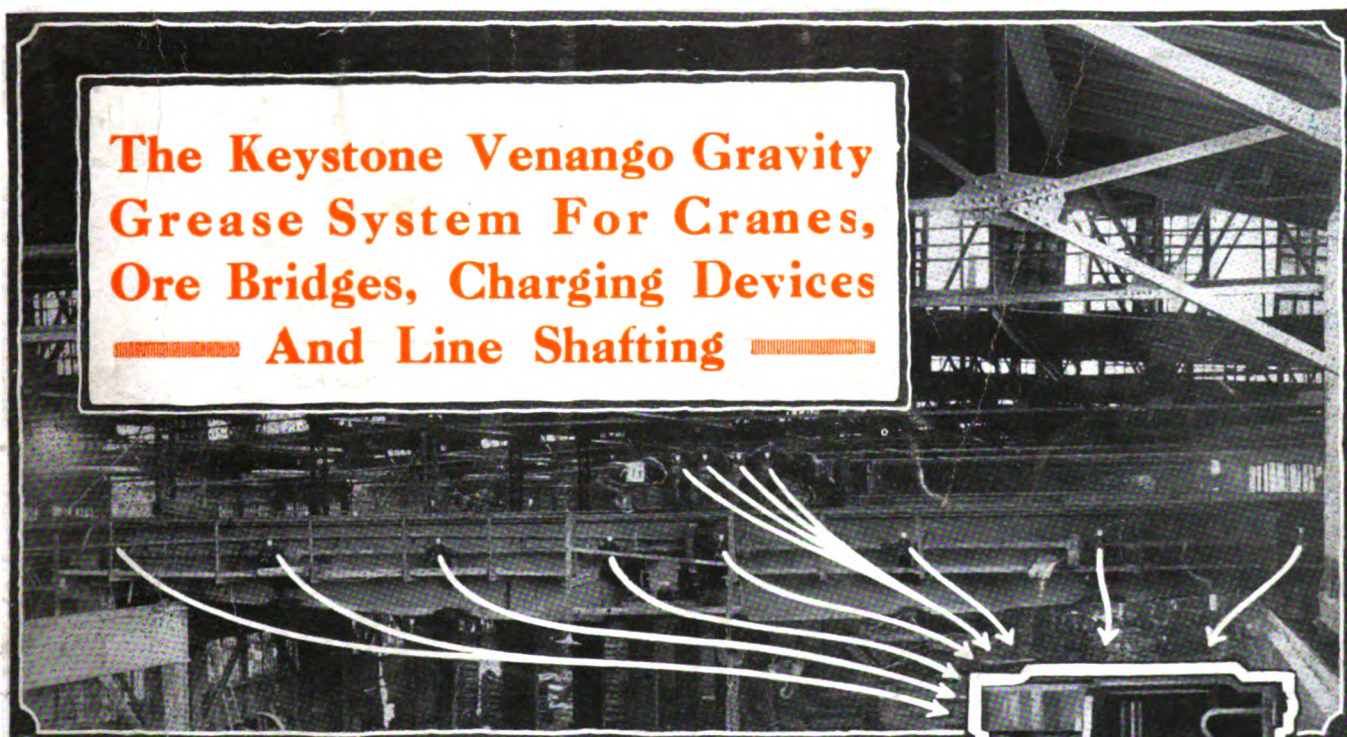
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The Blast Furnace *and* Steel Plant

Pittsburgh, February, 1918

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Grease System For Cranes,
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Continental European Offices, Paris, France, West Indian Office,
Havana, Cuba. Halifax, Nova Scotia.